ON THE SUPPLY OF HYDRAULIC POWER.*

BY MR. E. B. ELLINGTON.

The demand for the supply of motive power over considerable areas from a common source, which undoubtedly exists in the larger cities, is a new feature in our social economy, which it is for those practically engaged in the field of mechanical science to recognize and provide for. There are many methods of distribution available, and the conditions under which power is required are so various that it is hardly possible that any one system will be found capable of occupying the whole field. There are, however, good grounds for maintaining that hydraulic transmission, owing to its many advantages, is destined to become the most important means of distributing power in the central districts of our large towns.

Hydraulic machinery is now without a rival in docks and railway goods yards, and the great success which has been achieved by the hydraulic method in supplying the power needed by the great carrying companies has rendered possible the public supply of hydraulic power on the system which I have undertaken to bring under your notice. When it is proposed to supply motive power for public consumption within city areas, it must be understood that something more has to be accomplished than laying on a power already available, and which has only to be brought within reach of consumers. The power itself, whatever system may be adopted, has to be created. We can moreover go a step further, for nearly all the power we use at present has to be produced from the combustion of coal.

There are three elements in the problem: 1. The conversion of the power derived from combustion into the particular form adopted for transmission. 2. The transmission of the power in this form from the point of production to the place where the useful work has to be done. 3. The method by which the power is ultimately utilized.

Mechanical transmission, such as by shafting or ropes, compressed air, steam, electricity, gas or hydraulic power, have their common root in coal combustion, and all have certain well-defined peculiarities which enable one to judge of their suitability or unsuitability for the transmission of power over considerable areas. Shafting and rope transmission are obviously unsuitable owing to the great weight of material that has to be kept in constant motion. The system of distribution by compressed air has many supporters, but owing to the losses during compression and expansion, it does not appear that it can ever be an economical power. It is eminently successful where ventilation is as important a matter as motive power, and in such cases as the pneumatic dispatch, where the compressed or exhausted air performs the work in the tubes without the medium of further mechanism. It also renders most valuable service in the various operations connected with torpedo practice, tramways, and possibly in the near future railway locomotives, where reservoirs of power must be carried about, and lightness, and what I may term the stability of the power medium is essential. There are, however, special cases, and the proposals which have been made for distributing compressed air over large areas as a motive power have always contemplated such a system as is commonly used in mines, where the pressure is about 50 lbs. on the square inch, and where the efficiency to be obtained at the motor engine does not amount to more than 30 per cent. of the power developed by the air-compressing engines.

Apart from the question of efficiency it must be remembered that the low pressure at which the air mains would be charged would necessitate their being of large size and would yield the maximum of inconvenience in the streets. The great difficulty in detecting leakage and preventing waste would moreover probably prevent its supply becoming a remunerative operation.

The supply of steam for motive power, while of the same nature as compressed air, has some advantages and some disadvantages compared with it. While the compressed air can be used for cooling and ventilation, steam can be used for heating, but the heat which it contains by virtue of its being taken direct from the boiler renders it unstable as a motive power, and peculiarly unsuitable for distribution through the public streets of a city. In America the experiment has been tried, and it was only the other day that the collapse of the company in New York was announced. The inhabitants of New York are to be congratulated on this solution of the difficult position in which they were placed, as the city had become an active volcano—eruptions being of frequent occurrence. Motive power there certainly was, but hardly of the requisite kind. Unlike compressed air, leakages were only too easily discovered. Steam transmission has been tried and failed.

Gas has of late years come well to the front, and its great theoretical advantages have been brought before you on more than one occasion. One of the past-presidents of this section has stated his conviction that gas will most assuredly supersede steam as a motive force, and after what we have heard about steam in New York, and what we are daily hearing about gas engines, I think we may say that as a distributor of power it has at any rate superseded steam. The gas engine is a heat engine, and corresponds to the boiler in combination with the steam engine, when steam is used. After the power is produced in the gas engine it has to be distributed, and that which gas supply does is to make convenient and economical a large number of independent centers for the generation of power, and therefore the use of gas always involves the use of some other system besides itself. A gas engine employed in producing hydraulic pressure for distribution as motive power to various machines at considerable distances apart will give a higher efficiency in useful work in proportion to the power developed in the engine than if employed in any other way. I will give an illustration: Take the case of a wharf in which there are three or four cranes employed in lifting loads of 25 cwt. to a height of 80 ft., and suppose that it is required to raise this weight at a rate of 300 ft. per minute—not an unusual speed. The actual effective work done is 375 foot-tons per minute, or 26 horse-power. Supposing it were intended to do this work by a gas engine driving what would be called "direct," *i. e.*, by a system of straps, shafts, spurwheels, drums, chains, etc., really a very indirect method. The loss in driving the gas engine would be, say 30 per cent., and the loss in driving the other apparatus, namely, the lifting machinery, would be at least 40 per cent. of the net power derived from the gas engine. In order, therefore, to perform the work of raising 25 cwt. 80 ft. in a reasonable time, 60 horse-power must be developed in the gas engine, and even then it must be quite close to its work. If two cranes are to work at the same time there must be two such engines or 120 horse-power provided. Now, what result do we get from the apparently very indirect method of using the gas engine, not to drive the straps, shafting, etc., but a pump delivering water at a high pressure into an accumulator. A gas engine capable of developing only 30 horse-power will do the work of 120 horse-power in the former case, and, if necessary, a mile or more away from itself. One of Clark's 12 horse-power nominal gas engines working at Blackfriars Bridge has for some time been regularly working cranes similar to those just referred to at a wharf situated close to London Bridge.

It will of course be observed that the great economy arising in cases such as these by the use of hydraulic transmission is due mainly to the intermittent nature of the work, and that the result would be different were the power to be required in a continuous stream.

The chief demand for power in the great commercial cities is, however, of an intermittent character, and both *primâ facie* considerations and the experience already gained in connection with supply of hydraulic power in Hull show that, while the use of the power by individual consumers is of a very intermittent character, the total demand is comparatively constant. There being no more efficient way of using a gas or steam engine than to produce hydraulic pressure, there does not appear, therefore, to be any antecedent scientific obstacle to hydraulic power being economically used by small consumers, even where the power required is not obviously intermittent. I shall have occasion later on to refer again to the use of gas as a motive power, and I will now pass on to consider very briefly the remaining agent besides water now available for power transmission, *i. e.* electricity. I am not sufficiently acquainted with the technicalities of electrical science, and it would, moreover, be beyond the scope of this paper to enter at all fully into the very interesting and abstruse question of electrical transmission of power, but I do not think that electrical transmission will supersede hydraulic transmission for several reasons. I have endeavored to show how it is that the gas engine cannot do so, but electrical transmission of power starts heavily handicapped as compared with gas.

Electricity can only be produced in sufficient quantities for power transmission over a considerable area from some previously developed power, while gas is burnt direct in the receiving engine. The recent development of electrical mechanism has certainly brought us a step nearer to utilizing profitably some of the great powers of nature I have before referred to, but even supposing the electrical power laid on under the most favorable conditions, the power cannot be utilized except in the form of light without the aid of an electrical engine, and we have, therefore, again to face the problem as to the best method of distributing the power developed by the dynamo to the various machines which are ultimately to use this power. As, therefore, we have found that the gas engine cannot be more profitably employed than in producing hydraulic pressure, so, equally, will it be seen that when the electric motor has superseded the gas engine it will be economical and therefore desirable to use it also for producing hydraulic pressure.

If all this be true, how is it that hydraulic pressure remains, under the circumstances supposed, the most economical transmitter of power which we know of? Its superiority evidently arises from its being able to perform a large number of operations requiring power direct without the intervention of any receiving engine.

As the current of gas burnt in the gas-jet, or the current of electricity leaping across the carbon points or passing along the resisting carbon wire, produces light without the intervention of any further mechanism than the lamp itself, so the hydraulic pressure current is directly made to accomplish useful work without any further mechanism than the machine into which it is introduced. This condition does not hold true of any other method of transmission excepting in those systems which from other considerations are unsuitable for transmission of power over large areas. This peculiarity of hydraulic power is realized in almost all cases where rectilineal motion is required, and I have already shown how important its functions are wherever intermittent motion is needed in whatever direction. All lifting and pressing operations belong to both categories; and of the remaining demand for power to be supplied from any common center of distributing a very considerable proportion is intermittent.

Lifting appliances are becoming more essential every day, and it is most important that they should be made as safe as possible, as well as economical. Is it possible to conceive of any safer or more desirable apparatus for lifting purposes than the hydraulic ram? I draw your special attention to this because it aptly illustrates the direct action of hydraulic pressure. The whole apparatus only constitutes a slight modification of the hydraulic supply-pipe. There is the most perfect safety, the simplest structure and the greatest durability which it is possible for any lifting appliance to have. The chain hydraulic lifting apparatus is a little more complicated, but it is far the most effective chain hoist known for comparatively light loads. Almost all lifting operations can be carried on with these two machines. There is, of course, great variety in detail, but their main features are to be found in all hydraulic lifting appliances.

How important it is to the commerce of a city that it should be well fitted with lifting machinery will be patent to all when the weight of material daily passed through the streets of our cities is considered. In Liverpool, apart from the very extensive hydraulic appliances on the estate of the Mersey Docks and Harbor Board and the goods stations of the railway companies, there must be at least 1,500 hoists of various kinds at work. I have had enumerated over 1,000. The amount of material moved in and out of the warehouses and wharves on the Thames, within the area now being supplied with hydraulic power, is enormous, single wharves, not by any means of the largest size, moving 50,000 tons in the year.

Lifting is, of course, only one of the operations requiring power carried on in large cities. Pressing of various kinds is an important item and the driving of general machinery. The latter usually requires rotary motion, to obtain which from the hydraulic main a hydraulic engine must be used. The efficiency of a well designed and constructed hydraulic engine compares favorably with a gas engine, but the gas engine has the advantage of being more easily adjusted to develop the precise power required. There are, however, methods of automatically adjusting the power of a hydraulic engine, such as Hastie's, in which the throw of the cranks is varied. In many respects hydraulic engines are peculiarly adapted for city uses. They occupy a very small space indeed in proportion to the power, an engine to develop 20 horse-power only occupying about 8 square ft. They are steady in action and noiseless and require no attention. There is no heat or fear of explosion of any kind, and they can be readily started by turning on the tap. These are all advantages which will in a large number of cases determine their use irrespective of considerations of economy in working. There is one use for them to which I look forward with a good deal of interest, viz., to produce electrical currents by working dynamo machines. The dynamo machine requires uniform power, steadiness of action, and has generally to be worked in a confined space. My idea would be to supply power hydraulically to the various centers from which electricity could be distributed, and as the other demands for hydraulic power would be much less during darkness, the supply for such a purpose would offer an additional advantage. I hope during the coming winter to have the opportunity in London of testing the method, and I am sure it is worthy of the attention of electrical engineers.

I have not yet alluded to what is perhaps the most important property of hydraulic power to the general public, and of all other advantages the one which will go furthest to reconcile public opinion to the disturbance of the streets unfortu-

* Abstract of paper read before the British Association at Southport.

nately necessitated by its supply. It is the valuable assistance which it is capable of rendering toward the extinction of fires. The hydraulic power mains are in fact a continuous fire engine, and only require Greathead's injector hydrants fitted to them to render them available not only for throwing the pressure water direct on to the fire, but for giving the necessary pressure to the water supplied from the ordinary mains in the same way as a fire engine. It is, I believe, generally recognized by those having experience in dealing with fires that the force with which water is thrown upon the fire, especially in its earliest stages, is of more importance than its volume. The fire requires to be literally cut down. In London, owing to the very inefficient pressure that exists, the importance of this consideration in connection with the supply of hydraulic power cannot be overrated. The existing appliances are on all hands admitted to be insufficient, and the fire insurance offices themselves, usually so favorably disposed toward the element to which they owe their existence, appear to consider some improvement advisable in respect of the more crowded and valuable parts of the metropolis.

In passing rapidly in review some of the most important services which the public supply of hydraulic power is capable of rendering, I must not forget the point from which I started, viz., the question of the suitability of the power for distribution in the public streets. I have, I hope, shown how advantageous it is to obtain it, but can it be obtained with reasonable certainty, and without undue interference with the public interests? The whole question lies in a nutshell—disturbance of the streets in order to lay the mains. I cannot resist the temptation to make a slight divergence here in order to put in a word for subways. The existing condition of a crowded street underground, as well as above, is for the most part simply preposterous. That as mechanical science advances and population increases, new wants are created and new appliances for the common good are required, there will be a continually increasing demand for the use of public thoroughfares, other than for purposes of locomotion, is very evident. Instead, however, of the street authorities recognizing this, and taking upon themselves the duty of making their streets subserve the purposes required of them, any new demand upon the thoroughfares for common purposes is for the most part met with a *non possumus*, that no further disturbance of the streets is to be allowed. All crowded streets ought to have subways, and though it is difficult to express the value in figures, it can hardly be doubted that they would save to the public considerably more than their cost.

This, however, by the way—taking the streets as they run—hydraulic pressure pipes are as little obstructive as anything of the kind can be. In proportion to the power conveyed they are of very small size, the standard adopted being in London only 6 in. As remarked by Sir F. Bramwell, in his address to the section at the York meeting, hydraulic power can be conveyed in pipes of small diameter at a loss of only 2 per cent. per mile, The pipes being very strong, heavy and tested to 2,500 lbs. per sq. in. for a working pressure of 700 lbs., are very durable and require very little repair. In Hull, where about two miles of mains and branches are laid in the public streets under very unfavorable conditions, during the past six years it has only been necessary to do any repairs three or four times, and on no occasion during this period has the pressure been turned off during the daytime. Leakages in the main are diagnosed without much difficulty. The power used is registered by passing the water discharged from the machine through a meter, and waste is prevented by the same means. As a medium for distributing power water has no drawbacks. The water used for the purpose need not be chemically pure or drinkable, and is in general easily obtained. The quantity required is not large, 1,000,000 gallons in ten hours, representing a power equally distributed of 800 horses, which, owing to the intermittent demand, would be equal to the supply of from 2,000 to 3,000 horse-power to individual consumers.

Frost has not proved an impediment to the supply, as the mains are, as a rule, laid from 2 ft. to 4 ft. in the ground, and the water under pressure does not freeze so readily as under ordinary atmospheric conditions. The water is also in very cold weather raised in temperature before being delivered into the main. Should a pipe break the consequences are not serious. A leakage takes place, but it is often not immediately visible at the surface, and is only known in the first instance by the additional pumping required to make up for the loss.

On all grounds hydraulic power is proved to be pre-eminently suitable for public supply.

1. Because of its economy.
2. Because of the simplicity and durability of the machinery required to utilize it.
3. Because of its applicability to the extinction of fires.
4. Because of the ease with which it can be laid on and the small inconvenience its supply causes in the public thoroughfares.

Hydraulic power is now being supplied to the public in the manner advocated in the paper on Hull and London.

The works in Hull were of an experimental character. The plant has so far proved to be be considerably in excess of the demand, but there has been a steady increase of consumption since the commencement of supply, and the great economy of the power supplied on the public system has been fully demonstrated. The engines are capable of delivering 260 gallons of water per minute into the accumulator at 700 lbs. pressure per square inch. The water is taken from the River Hull at low water, when it is almost free from salt, and is allowed to settle in the tank over the engine-house, and then passed through gravel before being dumped into the mains. The cost of repair to the plant has been under £30 per annum for the six years, and its present condition is such that the leakages throughout the system, including those in consumers' machines, do not amount to more than 10 gallons per hour. In some instances, when tested, it has been found as low as 4 gallons per hour, the accumulator having maintained the pressure in the mains from the time of stopping the engines on Saturday afternoon until Monday morning. The average charge for the power in Hull varies according to the business done, owing to the effect of a minimum quarterly charge for each connection; for the year 1882 it was nearly 5s. per 1,000 gallons used. The lowest rate in Hull is 4s. per 1,000 gallons. At this rate the cost per ton of material raised 50 ft. is from ¼d. to ½d., and in many of the hydraulic cranes and hoists, 45 per cent. of the indicated power of the pumping engines is realized in weight of goods raised, the efficiency of the pumping engines being 76 per cent. The combined efficiency is much higher in the case of hydraulic ram lifts or pressers, and as much as 70 per cent. can be obtained under the most favorable conditions, which is, I believe, nearly twice the efficiency that can be realized by any other system of supply applied to lifting purposes. No one who has not had the matter brought very forcibly under his notice can conceive how very wasteful the system is of each small user of power having his own producer. In Hull the majority of the hydraulic apparatus used have superseded hand labor, but in London motive power of some kind or other is very generally employed; I have been greatly astonished at the extravagant annual cost of much of the machinery in use. A proprietor of one of the largest wharves on the Thames informed me the other day that he reckoned that it cost him 6d. to do the work by steam that, according to the company's scale for hydraulic power, would cost only 1d. This is an extreme case, but during the past twelve months we have become acquainted with numerous instances where the cost of the hydraulic power is only one-fourth or one-fifth of the existing charges.

The fact that so many of these extravagant appliances are in use—extravagant that is, when compared with the economy of the combined system—shows the urgency of the demand for power, and the great advantage of hydraulic transmission.

I have made a calculation as to the coal consumption in working 500 cranes or hoists assuming that they are worked with independent engines. It would probably amount to about 25,000 tons in the year. The same number worked from a common center by hydraulic pressure would not consume more than 2,500 tons. The influence therefore of the supply of hydraulic power on smoke abatement is not to be lost sight of.

In addition to the waste of coal there is the waste of labor; 50 men on the combined hydraulic system will produce more effect than 500 on the isolated system. There is reduction of cost on first outlay on machinery, and valuable space is also saved.

The general system in London is the same as at Hull, but compound condensing engines have been used of a vertical type to save ground space. The engines have each one high-pressure, and two low-pressure cylinders, and will each deliver 240 gallons per minute into the accumulator at a pressure of 800 lbs. per square inch, with 80 lbs. steam pressure. Space is provided in the engine houses for six such sets. The water taken from the river is then filtered through sponge in the Thames filter of the Pulsometer Engineering Company, and there is a difference of level of 7 ft. between the unfiltered and the filtered water tanks in order to give sufficient head to pass the water from one to the other by gravity. The mains are 6 in. in diameter; four of these mains radiate from the pumping station and are laid in circuit with stop and momentum valves at intervals, so that a short section can be shut off at any time without interfering with the remainder of the circuit.

There are two accumulators with rams 20 in. in diameter, 23 ft. stroke, and others will be added when needed at various points along the main; ultimately additional pumping stations will be required. The hydraulic pumping engines, accumulators, etc., both for London and Hull were made by the Hydraulic Engineering Co. at Chester.

With a comparatively new undertaking of this kind it was considered wise to lay out the plant in such a manner that it can be easily added to, but at the same time without incurring any excessive expenditure in the first instance. It was partly from this cause and partly from the great difficulty and uncertainty attaching to the operation of laying mains in any of the London streets which made us settle on laying the mains of so small a diameter as six inches. There is ample capaclty for proving the economy and the public and private advantage of the supply of hydraulic power on a large scale, and I have no doubt that its use will spread more and more until the system will be found in successful operation in all the important centers of our commerce.

A MAGNETO-ELECTRIC CALL BELL.

An ingenious call bell dispensing with batteries in telephony has been invented by M. Abdank-Abakanowicz. It is especially useful in long distance telephoning where relays would have to be used for the call bells or else a very powerful battery. The transmitter consists of a U magnet, between the branches of which is placed a bobbin having a soft iron core. This bobbin is carried by a spring fixed at its other end to a solid support or frame. The bobbin is withdrawn from its position of equilibrium between the poles by means of a handle attached to the frame of the coil. Under the action of the spring the bobbin oscillates between the poles, thereby setting up undulatory currents of electricity in the bobbin, which is in circuit with the line. These currents last some seconds until the bobbin takes up its normal position of rest. After traversing the line they pass through a receiver consisting of a similar bobbin carried by a spring in a magnetic field. This bobbin is, however, fitted with a bell clapper, and when it oscillates with the magneto current it strikes the two gongs or bell plates.

A NATURAL AQUEDUCT IN GREENLAND.

Nordenskjold has sent a report of his expedition into Greenland. Small cavities were met with frequently and were found to contain a muddy sediment, which Nordenskjold names kryokonite. This, he believes, is formed of dust driven over the inland ice by wind, but mixed with what Nordenskjold is convinced is metallic dust from cosmical space. Altogether, there must be a vast quantity of this substance spread over the interior; it appears to melt the ice beneath it, and when the thaw comes sinks down into these cavities, which, curiously, never freeze over sufficiently to bear the weight of a man. Quantities of the sediment referred to have been brought home, and the result of its analysis will be looked for with interest.

The sixth camping place of the expedition was an exception to the general rule. It was a small, level spot, surrounded by rivers and almost free from the troublesome cavities spoken of. The rivers flowed into a small lake, the water of which discharged itself with a thunderous roar into an abyss on the plateau. One river flowed through a deep ravine, a sort of ice cañon, with perpendicular sides. The scene was so beautiful that Nordenskjold had it photographed, but no description, he says, can give any idea of the beauty of the scene; it was like an aqueduct cut in the finest and purest marble, without spot or blemish. Even the stolid Lapps gazed at it with admiration. Soon the rate of travel increased, and six to eight miles a day were easily done, the ascent being very rapid, their ninth camp being 2,400 ft, above the sea. Besides the kryokonite above spoken of, nothing in the shape of stone or mineral was found in all the interior; not a speck of sand even, not the tiniest pebble.

MARYLAND STATE SANITARY CONVENTION,

UNDER THE AUSPICES OF THE STATE BOARD OF HEALTH.

TIME AND PLACE OF MEETING.—You are cordially invited to be present at the sessions of a Sanitary Convention, which will be held in the City of Baltimore, Md., on Tuesday and Wednesday, the 27th and 28th of November, 1883.

SESSIONS.—There will be sessions the first day at 12 m. and 7:30 p. m.; on the second day at 10:30 a. m., 3 p. m. and 7:30 p. m. During each session of the convention there will be one or more addresses or papers on some subject of general interest pertaining to public health, each paper to be followed by a discussion of the subject treated.

SUBJECTS.—The following subjects will be open to discussion: Ventilation, House Drainage and Sewerage, Distribution and Purification of Water for Domestic Use, Hygiene of Public Establishments, Steamboats and Railway Cars, Contagious and Infectious Diseases, Injuries to Health from Overflowed Lands and from Mill-Dams and Other Obstructions in Rivers, School Life and Hygiene, Causes of Insanity, Malaria, Vaccination and Vital Statistics, Sale of Poisons, Laws Regulating the Practice of Medicine and Surgery, etc., etc.

Papers upon any of the above subjects, or upon any subject germane to the public health are earnestly solicited, and will be, as far as practicable, published in the biennial report of the State Board of Health.

EXECUTIVE COMMITTEE.

From the State Medical Society: Dr. Richard McSherry, Dr. G. Lane Taneyhill.

From the City Board of Health: Dr. George W. Benson, Mr. A. R. Carter.

From the State Board of Health: Dr. J. Robert Ward, Dr. James A. Steuart, Dr. C. W. Chancellor.

COMMITTEE OF CITIZENS.

Dr. John Morris, Maj. Chas. H. Latrobe, Col. Henry Page, Judge David Fowler, Francis T. King, Esq., Hon. Lloyd Lowndes, Hon. Henry W. Archer, Dr. Geo. W. Bishop, Hon. Frederick Stone.

The above committees will meet jointly each day at the Carrollton Hotel, at 9 a. m., in parlors kindly tendered by Major F. W. Coleman.

OFFICERS OF THE CONVENTION.

(Chosen by the Executive Committee.)

President—Prof. Richard McSherry, M.D., Baltimore.

Vice-President—Hon. Lewis H. Steiner, Frederick City.

Vice-President—Henry C. Hallowell. Esq., Montgomery County.

Vice-President—Col. Edward Lloyd, Talbot County.

Vice-President—Hon. S. H. Coombs, St. Mary's County.

Vice-President—Col. Wm. Knight, Cecil County.

Permanent Secretary—C. W. Chancellor, M.D., Baltimore.

EXPLANATORY.

The object of these conventions is to awaken an interest in sanitary matters throughout the State, by bringing together for consultation all who feel an interest in public and personal hygiene, and who desire *to diffuse among the people such information as may secure exemption from avoidable causes of disease.* The occasional outbreak of local epidemics; the intimate relations of our State to tide-water and its proximity to the nidus of yellow fever; the spread of Asiatic cholera in the East and the possibility of its reaching our shores, render precautionary measures of the greatest importance at this time, and should arouse every section of the State to unusual activity in sanitary matters.

It is proposed to hold these conventions annually in various sections of the State, and in order to make them of the greatest importance, the Governor of the State, Members of the Legislature, all Mayors of cities, the authorities of towns, villages and counties, and citizens generally, especially physicians and clergymen, are cordially invited to attend and take part in the deliberations. All local Boards of Health, medical and pharmaceutical societies, associations of architects, engineers and plumbers, medical and other scientific institutions, railroad and manufacturing corporations are requested to send representatives.

Editors of newspapers and medical journals who are disposed to promote the sanitary welfare of the communities they represent are requested to call attention to these meetings, and it is especially desirable that they should be present in person or by proxy, so far as they may be able.

EXHIBITION OF SANITARY APPARATUS.

As an interesting feature, it was intended to invite manufacturers and dealers in all kinds of sanitary apparatus and appliances to send specimens of their articles for exhibition at this convention, but as the "Industrial Inter-State Exhibition Society of Baltimore" propose holding a general Exposition in 1884, and annually thereafter, it is deemed best by the committee to postpone the invitation until that time.

Further information may be obtained by addressing C. W. CHANCELLOR, M. D.,
Secretary State Board of Health, Baltimore, Md.

BOSTON STATE HOUSE IN DANGER.

BOSTON, Nov. 15.—Under the caption "The Boston State House in Danger" the *Transcript* to-night prints a thrilliug story two or three columns in length. The writer says:

When his Excellency boasted that at the raising of his hand his old veterans would assemble and clean out the State House, the public was little aware of the pressing need of the cleaning out of the Capitol. The enemy which has effected a lodgment under the gilded dome is small, but mighty, and his name is legion. He works in the dark and unceasingly. He is the Guy Fawkes whose plotting is perennial, the blowing up of whose mine is ever imminent. His point of attack is at the foundations, and his name is *Termes flavipes*, or, in vulgar parlance, the white ant. Nearly a year ago a document that has been stored in what is known as the "dungeon," in the basement of the State House, was found to have been eaten in a curious manner. The mischief was apparently the work of some insect, and, considering the amount and value of the books and papers contained in the State House, no time was lost in hunting up the name and character of the unknown foe. Knowing something of the researches of Dr. H. A. Hagen, Professor of Entomology of Harvard University, the Secretary of State sent to the Professor a sample of the eaten volume. The Professor instantly pronounced the culprit to be the white ant, and advised a thorough inspection of the State House, and that measures be taken to prevent further ravages by the pest. The attention of the Committee on the State House was called to the matter, but nothing was done by that body. Recent investigation, however, shows the work of the pest to be extensive and alarming.

Prof. Hagen was interviewed on the subject. He considered the presence of the white ants in the State House as a matter for genuine alarm. It might be found, he said, that the State House is not so substantial a building as it appeared to be. He spoke of their operations at the works of Alvan Clark & Sons, the celebrated makers of astronomical instruments, where the supports of a building were destroyed; also of the destruction of a bridge at Porter's Station some years ago, and of various mysterious building disasters, which probably were due to the ravages of this insect. The nest of the ants which have entered the State House is undoubtedly some distance away, probably in the Common or Public Garden, or possibly in one of the small private gardens or old trees in the vicinity. It is the habit of the white ant to have its nest as far away as possible from the point where it appears above ground. Killing the insects will not do, said the Professor: they must be prevented from entering a building by the use of cement and metal in place of wood. In conclusion, the alarmed officials at the State House will make an appeal to the next Legislature for protection against this worse than a political enemy.

AN ELECTRIC COUNTER.

Mr. J. Cauderay has devised an electric counter or coulomb meter, which is exceedingly simple. It consists of a cylinder turning by clockwork at the rate of one turn per second. The cylinder is furnished with teeth like the barrel of a musical box, and arranged in circles at equal distances from each other. The middle circle, which divides the cylinder into two equal parts, has no teeth. On each of the circles next to it there is one tooth, on those next that again, two teeth, on those next that again, three teeth, and so on. The needle of a suitable ampère meter or ammeter is adjusted so that its zero position brings it tangential to the middle circle on the barrel. When, however, a current of one ampère flows through the ammeter the needle is deflected to the first circle, and there the first tooth striking it works a counting apparatus. As the barrel rotates once per second, and the first circle has only one tooth, the counter records the number of coulombs. Similarly when the current is two ampères strong the needle is tangential to the second circle, and is acted only by two teeth, thus giving the number of coulombs also.

THE FIRE RISKS OF ELECTRIC LIGHTING.*

BY KILLINGWORTH HEDGES.

There is a great difference between the electric currents which have been in constant use for telegraphic purposes, and those which are to be supplied by the undertakers under the Electric Lighting act. The latter can only be said to be free from danger when the heat generated by the current is utilized in its right place, and not developed in the conductors or wires which lead the electricity to the incandescent lamps.

The Fire Risk Committee have already issued rules for guidance of users of electric light; these can hardly be said to embrace all the salient points of the new subject, which can only be arrived at after years of practical work. The necessity of proper regulations has already been recognized by the insurance offices, both in the United States and Germany, and some of their special rules are given in this paper.

The conductors must be properly proportioned for the current they have to carry; whatever resistance there is in the conductor will cause a corresponding development of heat, which will vary with the amount of electricity passing, and inversely as the sectional area.

The material must be free from impurity, otherwise an impure section will increase the resistance. The extraordinary difference in the conducting power of a sample of "commercial" Rio Tinto copper wire, as compared with the pure metal, was shown in an experiment by Dr. Matthiessen—the conducting power being only 13.6 as against 99.95 for pure copper.

The continued heating of an impure metallic conductor has a certain effect on its electrical resistance. With the sample just mentioned, the conducting power at 100 deg. Cent. decreased from 13.58 to 13.558 after the wire had been heated for three days. It does not always follow that there will be a decrease in the conducting power, as, with alloys, the opposite effect is produced. A copper-silver alloy showed an increase of .264, after having been heated to 100 deg. Cent. for three days, and a tin-copper, an increase of .13.

As the temperature in Dr. Matthiessen's experiments was not increased over 100 deg. Cent., the author has made some further experiments—heating the wires by the electric current from a secondary battery, to within a few degrees of their melting-point.

The following materials were tried—the wires and foils having such sectional area, and so arranged that, on the current being increased by 20 per cent., they were immediately fused.

The total length of each experiment was twenty-four hours, during which time the current passing through varied slightly, and the following is a mean of the results:

Material.	Resistance before heating.	Resistance of leads.	Difference after 24 hours.
	ohms.	ohms.	
No. 1. Commercial tin wire	.815	.8	—.003
" 2. Lead soft	.835	.8	—.005
" 3. Copper, soft	.81	.8	No change
" 4. Pure tinfoil	.86	.8	No change
" 5. Tin and lead alloy	.87	.8	—.160
" 6. Albo alloy, in foil	.835	.8	No change
" 7. Aluminium and tin alloy	.82	.8	+.0008

The resistances were in all cases taken at the temperature of the air, which averaged 69 deg.

The sign — shows that the metal decreased in resistance, and + that it increased after continued heating. Nos. 1 and 3, tin and copper, were found to scale when heated.

A change has been noticed where high tension currents have been sent through a pure copper wire for some time—the wire in the armature of a Siemens machine, which came under the notice of the author, appeared to be brittle, and gave a fracture unlike pure copper.

The necessity of good electrical connections is very great, also special arrangements of switches and contact breakers which, when left in unskilled hands, are liable to cause dangerous heating or an arc.

Short circuit is the danger which may be caused by badly arranged wires; most likely a conflagration will ensue without the remedy suggested by the Fire Risk Committee and the Board of Trade is adopted—of having a cut-out or fusible plug in the circuit which gives way when the current is in excess. These should be arranged to melt if the current is more than ten or fifteen per cent. over the working strength, otherwise absolute safety is not arrived at. Ordinary lead or tin wire cannot be used except for very small currents, as on fusing the metal is scattered in a globular form, when it is liable to cause fire. The plan adopted by the author is to take pieces of foil arranged like the leaves of a book; the thinness of the foil causes it to be almost volatilized when melted. The material found to be the most reliable is a special alloy of aluminium, termed Albo metal, which is extremely tough, and can be worked much nearer to its fusing point than tin or lead.

The safety of an electric light installation is only insured by testing, which should be done by a current of higher electromotive force than it is intended to use.

When the work has been properly supervised no trouble should be experienced, and the electric light may be said to be much safer than gas, as it is free from those accidents which are due to a servant's carelessness, or by leakage of the pipes. Whatever danger there is with electric lighting is entirely localized to the generating station, where the dynamos and engines would be under constant supervision.

* Read at the Southport Meeting of the British Association.

A NEW ITALIAN RAILROAD.

[Rieti Dispatch to the London Daily News.]

The new railway from Terni to Aquila was opened to-day by the Minister of Public Works as representative of the King. This railway is of the greatest importance to Italy both strategically and commercially—from the former point of view, as connecting the Adriatic at Pescara with the capital; from the latter, as forming an outlet for the rich agricultural produce of the Abruzzi. To the English tourist, on the other hand, it opens up a tract of country no less interesting for the wild beauty of its highland scenery than for the wealth of its historic associations. The train, with some 300 guests, left Rome at 8 this morning, and, proceeding up the romantic Valley of the Nera, passed rock-enthroned Narni, with the ruins of its Augustan bridge, once as much the wonder of the ancient engineering world as Brooklyn Bridge is of the modern. We reached Terni at 10:30 o'clock. Here another band of guests was taken up, and two trains being formed each with two engines,

we proceeded on the new line up the Valley of the Stoncone, through six tunnels, to the Marmore, where a halt was made for lunch and for the inspection of the famous waterfall of Velino, so graphically described by Byron in "Childe Harold." Hence our way, skirting the slumbrous emerald green Lake of Piediluco, lay through the fertile upland plain of the Velino to Rieti, formerly one of the most important towns of the Sabine country. At 6 the train reached this place (Aquila) so famous in the history of German raids into Italy, and which the Emperor Frederick II. intended to make the capital of the country. The importance of to-day's event is evidently appreciated by the local population, who everywhere came trooping down from their high-perched mediæval townships and cheered lustily as the train went by, the harbinger for them of a new civilization.

THE HISTORY AND STATISTICS OF AMERICAN WATER-WORKS.

BY J. JAMES R. CROES, M. AM. SOC. C. E.

(*Continued from page* 532.)

DLXXV.—EL PASO, TEX.

El Paso, Texas, in lat. 32° N., long. 107° W., on the Rio Grande, is in a dry and sandy valley of a mountainous country.

The town was settled in 1827 and was incorporated a village in 1853 and a city in 1878.

Water-works were built in 1882 by a private company, after plans of Sylvester Watts, taking the supply from the Rio Grande. Along the course of this river dams of clay, rip-rap and boulders are constructed at every town for diverting the water into irrigating ditches. From above the dam at El Paso the water is pumped 200 ft. by a steam pump of two million gallons daily capacity, built by Smith, Vaile & Co., and also a Worthington pump for fire protection, into a settling reservoir holding 2,000,000 gallons. The water contains a great deal of fire clay sediment. After settling, it is drawn into a distributing reservoir of 3,500,000 gallons capacity 180 ft. above the city. The ordinary pressure is 65 lbs. and the fire pressure 85 lbs. Distribution is by 5 miles of wrought iron pipe of 11 to 4 in. diameter, with 27 fire hydrants, 13 gates and 170 taps. There are 128 meters in use. The city pays $100 per year for each hydrant. Service pipes are of wrought iron.

The population in 1880 was 736. It is claimed to be 5,000 in 1883. The daily consumption is 1,000,000 gallons.

The capital stock of the Company is $80,000. The works cost $70,000. The bonded debt is $80,000 at 6 per cent. The annual expenses are $6,000 and the receipts $12,000.

H. A. Lawton is Secretary of the Company and William H. Watts the Superintendent.

DISPOSAL OF CHICAGO SEWAGE.

Before the Chicago Pathological Society meeting at the College of Physicians and Surgeons Dr. J. Frank Lydston read a paper on "Modern Sanitation; Some of Its Fallacies and Its Relation to Zymotic Diseases." He said it was impossible to devise any system of plumbing that was absolutely perfect; that however carefully plumbing was done it vary rarely remained perfect for a year on account of the corroding of the pipes. As to the water-closet, he claimed that it was absolutely impossible to construct a trap that would prevent the escape of gases either during use or the time when the trap was pulled open. Where it was necessary to use some form of trap there should be a double valve, one being closed while the other was open. Sufficiently strong disinfectants should be used to thoroughly decompose and destroy any germs or gases that passed through the water. Buildings being composed of porous materials, they were exposed to the emanations from animal bodies whether healthy or diseased, and in time became thoroughly saturated with them, and the ordinary way of disinfecting was absolutely ineffectual to destroy them. Hospitals should be cheaply but substantially built on the pavilion floor, and, after being used a year or two, thrown open to the air and sunshine, and, in a few more years, burned. He ridiculed the course of some physicians and city health authorities in attempting "to disinfect by substituting the stench of various chemicals for that arising from the various processes of putrefaction." They simply disguised the smell, and did not destroy the noxious properties of the emanations arising from putrefying substances. There should be more of pure water, sunshine, God's oxygen, and less disinfectants.

Dr. Romaine J. Curtiss, of Joliet, followed in a paper on "The Disposal of Chicago Sewage." In contemplating the subject, he thought all people would admit that experience had demonstrated two facts, one of which was that sewage ought not to be turned into running streams, and the other that the object in disposal of sewage should be to prevent its putrefaction. There was no method of promoting putrefaction more effectual than turning the sewage into shallow streams, as canals and small rivers, like the Illinois & Michigan Canal, the Desplaines, and the Illinois. The science of hygiene taught us that the true method of disposal of all organic matter which was dead was to aid its restoration to life, and the two methods of bringing this result about was the economy of lucre and the economy of life; and also in the economy of nature was to either directly oxidize the dead matter by fire, or to turn it directly into a condition of as perfect dilution as possible upon the roots of growing plants.

The present methods of disposal of Chicago sewage violated every factor of hygiene relating to economy of life in all factors, the economy of wealth, and also, in a measure, the economy of nature. The sewage was turned into the Michigan Canal from the river (at least all that could be turned in was), and then began the process of putrefaction. There was dilution enough and heat enough to aid and give comfort to the agents of putrefaction, and the general result was that Chicago sewage was very much like Barnum's show in point of magnitude; it was the only greatest nuisance on earth. The efforts that had been made by the city to get rid of its sewage, though backed by great expense, had certainly all been more or less failures. Though these efforts had succeeded in burdening the country with an outrageous nuisance of the worst possible sanitary character, yet the river of Chicago was still an elongated cesspool. The effort of the city, and perhaps some other people, had always been to dispose of the sewage by the outrageously unsanitary method of turning it into the canal. The method provided every facility for putrefaction of the sewage instead of employing any method to prevent it. Instead of being sanitary it was simply an immense breeding-hospital for infection, embracing in its influence nearly half the people of the State. Nobody had even hinted at the use of disinfectants or of fertilizing establishments, or of any method, or of anything except to get the sewage by some means or any means into the canal and let it putrefy; and it might be said that the only things learned or realized from all the efforts were that sewage would putrefy and stink; but even in this condition it could turn a water-wheel, if it did turn the stomachs of the people wrong side out and turn their toes upward with that extenso flexion which returned the embrace of death. The theory that adding water to the sewage would somehow cause it to oxidize was a delusion.

After adverting to the question in relation to the public health he said Chicago sewage had tempted epidemics for several years, while the public held the delusions that oxygen was the agent of putrefaction, and that dilution of sewage would oxidize it without putrefaction, and that the canal method of sewage disposal was sanitary. The public would very likely continue to attempt the solution of the sewage problem in this manner until cholera taught them a thing or two about the sanitation of sewage. If Sisyphus was made mad by the gods, and continued to roll the stone up the mountain as often as it has rolled down, then it was very likely that he continued the vain and foolhardy business while his ghost continued to live, unless an earthquake leveled his mountain or the gods relented. At present the burden of the prayers of the people who lived in the burnt district of Chicago sewage was, "How long, O Lord, how long!"

THE CANNON, THE STEAM ENGINE, MAN, AND THE INSECT CONSIDERED AS MECHANICAL MOTORS.

Under the above title, we give a résumé of some very curious and interesting information published in a recent work of Mr. E. Jouffret, entitled "Introduction to the Theory of Energy."

These examples, which are submitted in a simple and clear way, are well calculated for disseminating a knowledge of the phenomena of conservation and transformation of energy, by presenting them under a concrete form accessible to all those who are not making a special and continued study of them.

A 100-ton cannon (Italian model of 1879) costs 400,000 francs. It requires a 250 kilogramme charge of powder, and throws a projectile weighing 917 kilogrammes, with an initial velocity, at the mouth of the cannon, of 523 meters per second.

The energy possessed by the projectile, in the form of live power, is 12,772,000 kilogrammeters.

The energy represented by one kilogramme of powder is, according to Noble and Abel, 300,000 kilogrammeters, or 75,000,000 kilogrammeters for the charge of 250 kilogrammes.

The *cannon*, considered as a machine, converts then into work *seventeen per cent.* of the total energy of the combustion of the powder. This figure is higher than that furnished by the best steam engines, as these convert into work less than ten per cent. of the total energy represented by the coal.

It is the animal machine in which the performance is the highest, and this fact may be established, in a particular case, as follows:

According to the *Guide Joanne*, the ascent of Mont Blanc, starting from Chamounix, is effected in seventeen hours, resting spells not included. The difference of level is 3,760 meters. A person ascending, who has a mean weight of 70 kilogrammes, produces, then, in order to rise, a work of $3{,}760 \times 70 = 263{,}000$ kilogrammeters. This work is borrowed from the heat that the carbon and hydrogen contained in the food eaten disengages upon being burned in the lungs. For the sake of simplicity, if we reduce the entire energy to a combustion of carbon, and recall that a kilogramme of the latter furnishes 3,000,000 kilogrammeters, we find that the 263,000 kilogrammeters represented by the ascent correspond to a consumption of 94 grammes of coal—a consumption that comes to be added to the normal rations necessary for the operation of the organs during a state of rest. Such consumption is 8.35 grammes per hour, or 142 grammes for the seventeen hours. The total consumption of coal is 256 grammes, representing 708,000 kilogrammeters. The performance, then, is

$$\frac{263{,}000}{708{,}000} = 37 \text{ per cent.}$$

The performance of the human machine drops to 21 per cent. when we consider a period of twenty-four hours composed of ten hours of work and fourteen of rest, and a mean daily work of 280,000 kilogrammeters.

The cannon, considered as a machine, is incomparably superior to the steam-engine as regards the time necessary to produce a given quantity of mechanical work.

Thus, for example, the 100-ton cannon develops in *one-hundredth of a second* a quantity of work equal to that which would be yielded by a 47 horse-power steam engine *in one hour*. A man of average strength is still lighter than an ordinary steam-engine of equal power, but he is much inferior to the other animals of creation, and particularly to insects.

Thus, for example, the libellula, which is capable, without apparent fatigue, of following a train of cars for several hours, giving its wings during this whole time some thousands of backward and forward motions per second, is a hundred times lighter than a steam engine capable of producing an equivalent work.

This is what renders the problem of aerial locomotion so difficult, and, as Mr. Hirn says, it explains why we can fly in imagination only.—*La Nature.*

NICKEL DISCOVERIES.

It has long been known to intelligent prospectors that nickel is associated with other metals in the metalliferous veins traversing the metamorphosed granite, quartz diorite and slate belt (from three to seven miles in width) separating the quartz-porphyry that skirts the volcanic valley of Mono Lake from the hornblendic or cynetic granite constituting the summit of the Sierra Nevada chain, and extending from Green Creek, north to Castle Peak, to the North Fork of Rush Creek, south of Mount Lyell, a distance of 25 miles or more. Float rock carrying from 8½ to 9½ per cent. of nickel, $15 to $18 per ton in silver and a trace of gold has been found in considerable quantities on Virginia Creek, near the base of Castle Peak, and it was probably the presence of a large percentage of nickel that prevented the successful working of the rich auriferous ores of the Dunderburg mine, at the northern base of that peak, years ago. In some places along the outcrop of the Sheepherder lode of the Great Sierra Company, on Tioga Hill, 12 miles further south, where the slate has displaced the granite of the summit, and crossed diagonally over the western slope nickel, it is also found in considerable quantities: but the shaft sunk over the tunnel shows that it does not follow the vein down more than 40 feet. An occasional trace of this metal is also found in the free gold ores of this district. Andrew Thompson and John Hall have recently made a discovery on Iron (or White Wolf) Mountain, five miles south of Tioga Hill, which bids fair to prove the *veta madre* of nickel in this section. They sunk down on the solid vein about 15 ft., and cross-cut 14 ft., without finding any traces of either wall. The lode is on a gentle slope of a low slate mountain, the surface of which was polished by a glacier which moved northward from Mount Lyell and eroded the cañon or valley now occupied by the Dana Fork of Tuolumne, but this surface has since weathered until it is covered with sufficient soil to support a heavy forest of pine, and hence the outline of the lode cannot be traced on the surface, but the indications are that it is 60 feet. So far as the vein has been opened, the ore appears to be of very uniform grade, except a few small streaks of barren quartz, and an average sample sent to San Francisco for analysis gave a return of 34 per cent. nickel, $17 per ton in silver

and a trace of gold. When run out by the recent storm, the owners were not aware of either the nature or value of their discovery, as they did not get returns from the assayer until they came in, but were drilling away through the "iron" in search of silver.

A NEW METHOD OF SEWER VENTILATION.

An English apparatus by Mr. T. S. Wilson, F.S.I., and Mr. H. T. Johnson, is called the patent hygienic furnace. Profiting by the proximity of the gas mains to the sewers, the patentees have constructed a gas furnace to be inserted in the manholes. The gas is introduced into a little chamber, where it is mixed with a due proportion of air and supplies some Bunsen burners. Immediately above the gas there are some fire-clay plates, which soon become heated; while above them are iron divisions. The heat naturally draws the air up from the sewer below; it passes through the Bunsen burners backward and forward over the fireclay plates and iron divisions, till at last it finds its exit in the ventilation chamber or manhole, and hence through the grate into the street. The furnace not only causes a strong current of air from the sewer, but, as it is capable of being heated at from 600° to 700° Fahr., it should destroy all the germ life that travels with the sewer gas. Experiments with sterilized infusions of meat have been made, and whereas ordinary air drawn from the street soon caused the infusions to become turbid with animalcules and fungoid life, no such effect was produced by the sewer air taken after it had passed through this furnace.

PRACTICAL HINTS REGARDING TORNADOES.

JOHN D. PARKER, U. S. A.

The following hints regarding tornadoes are given in the belief that many people are killed every year who could save their lives by a little practical knowledge of the movements of these destructive storms.

The tornado *season* is embraced between the 1st of April and the 1st of September, but in the latitude of Kansas City most tornadoes occur in the months of May and June. As we go north or south of this latitude they are proportionally earlier or later, and early or late seasons vary the time of their occurrence correspondingly.

Tornadoes occur in the *afternoon*, generally between two o'clock and evening, four o'clock being called the tornado hour.

Tornadoes move from southwest to northeast, generally *east about twenty degrees north*, and their linear movement is ordinarily from thirty to forty miles an hour.

Tornadoes occur on *sultry* days, or when the temperature is very high and the air is thoroughly saturated with moisture.

Tornadoes occur when the *electrical conditions are high*, or when the air is highly charged with electricity.

The approach of a tornado may be known by ominous clouds appearing in the southwest and northwest. The clouds sometimes resemble the smoke of a haystack, at other times they appear like iridescent fog. Sometimes they present a deep greenish hue, or are intensely black, or have a purplish, yellowish, or bluish tinge. When these two masses or banks of clouds, under the impulse of opposing currents, approach each other they are thrown into great confusion: there is a roaring, likened to the rumbling of distant thunder, and an upward expulsion of air and vapor. Soon the funnel of the tornado is let down to the earth and moves to the front, while scuds of clouds play around it. The tornado now formed has four characteristic movements: a linear movement toward the northeast; a gyratory movement (north of the equator), contrary to the hands of a watch; a zigzag or swaying movement, which leaves dentated edges in the path of the tornado; and a rising and falling movement, the poise of the upper current, by which the tornado leaps over portions of its path.

If one is familiar with these premonitory signs he is put on his guard, and when the tornado appears he is prepared to act intelligently and promptly. Under the preceding principles he can easily determine the projected path of the tornado, from the location of the funnel, and whether it will be necessary to run north or south to escape from it. He must, of course, not run east or west.

When a tornado is imminent, certain precautions should be observed. Doors and windows in houses should be closed, animals in harness unhitched, and animals in stables let out. The safest place in a house is the southwest corner on the first floor, or better perhaps, the southwest corner in the cellar. If a tornado overtakes one on a prairie, lie face downward, head toward the east, and place the hands over the head for protection. If near a low, solid object, like a large stone or stump, lie face downward, east of it, head toward the object, with hands over the head for protection.

Every home should have a dug-out at a convenient distance from the house, or, what is better, a tornado room built into the west or south wall of the cellar, large enough for the family, and for things of great value like deeds or money.

The destructive effects of tornadoes result from the gyratory movement, which is estimated from one hundred to five hundred miles an hour. Tornadoes with the hour-glass form of cloud are the most intense, and seem to be irresistible, but the greater number of tornadoes are of a lower intensity and we can build against them. Frame houses are more tenacious or elastic than brick or stone, and when overthrown are not so destructive to life. They should have strong frames. Brick houses should have an extra layer of brick laid in cement in the west and south walls. Some houses with very thick walls laid in cement are comparatively safe against most tornadoes.

Houses built near a hill or bluff presenting an elevation should be located on the northeast side, as the elevation tends to lift the tornado over the house. A grove of hard wood, such as oak, maple, walnut, and hickory, southwest of a house, or a forest southwest of a town, has a tendency to break the force of a tornado and drive it into the upper air, although it is not safe for a person to be near a tree or in a grove during a tornado, for fear of being struck by flying timber. Occasionally a tornado of great intensity will cut a clean swath through a grove, but forests tend to break the force of tornadoes, and will drive most of them into the upper air. All towns in prairie States should plant heavy groves of hard timber southwest of them. During a residence of forty years in southern Michigan when it was heavily timbered tornadoes were unknown, that is, they were driven into the upper air and rendered harmless; but since the forests have been cut away tornadoes in that part of the State have become somewhat frequent and destructive. Not to build and protect against tornadoes seems like not taking medicine for fevers. Sometimes a fever proves fatal, but most fevers can be cured, and so most tornadoes can be rendered comparatively harmless.

By a careful study of the principles which underlie these storms and an observance of the premonitory signs during the tornado season it is believed that few, if any, persons who keep their presence of mind and act intelligently and promptly when the storm appears need be killed by a tornado. Still, it is always best to have a clear conscience whatever may happen.

Meteorologists are carefully studying these storms. The Signal Service already, in their daily reports during the season, indicate the barometric trough of low pressure, extending from the southwest toward the northeast, along which tornadoes move, and it is believed that the time is not far distant when they will predict to certain districts probable tornado days.—*Kansas City Review.*

THE IRON TRADE.

The Bay View Fishplate Mill and the North Chicago Rolling Mill closed yesterday, throwing several hundred men out of employment. The shut down was owing to a lack of orders, the season for rail laying being about over. The Cleveland Steel Works will close on the last day of this month.

CLEVELAND, NOV. 15.—There is considerable excitement in iron circles here over the rumored embarrassment of the Lawrence Iron Company, of New Castle, Penn., in which several Cleveland iron firms are more or less interested. An iron man said that the company's trouble grew largely out of reports of its embarrassment set afloat by an agent of one of the commercial agencies, who is alleged to have a spite against it. Creditors swooped down on the firm, and, although the agent a day or two later partially retracted from the former report, the Lawrence Company was driven to close quarters, when many believed it could have otherwise pulled through easily. W. H. McCurdy's firm, of Cleveland, filed a claim of $10,000 against the troubled firm. The senior member of the firm of J. H. Outhwatie & Co. said that the Lawrence Company recently sold its furnace for $90,000, with which money the creditors expected to be paid, but for some unexplained reason they were not. Hence they hustled down from Cleveland to investigate. The liabilities are about $250,000.

TROY, N. Y., NOV. 15.—Superintendent Hunt, of the Rensselaer Rail Mill, the Albany Iron Works, and the Bessemer Steel Works, says the outlook for work in the iron mills this Winter is very poor and that a shut-down very soon can not be helped. He says the mills cannot afford to make rails to sell at $35 per ton because it would be at a loss. The iron and steel market is overstocked, and his recent trip through the West plainly showed him that. The few mills that are selling for these prices are doing so at a heavy loss, and a panic will soon follow. In case the mills here shut down several hundred men will be thrown out of work, and Troy will suffer a severe blow.

CLEVELAND, NOV. 15.—The Cleveland Rolling Mill Company's works have been going somewhat lightly in work for some time past, but the managers now say that there is a prospect for steady work the rest of the year. The rail mill started up again to-day, and the hammer department of the plate mill was set going yesterday.

A BIG ORE CONTRACT.—NASHVILLE, Tenn., Nov. 15.—The largest ore contract ever made in the South was closed to-day by Mr. Shook, General Manager of the Tennessee Coal, Iron & Railroad Company, with Messrs. G. P. Curting & Co. The contract runs over a period of six years, and is for mining 600,000 tons of ore. Under this contract ore is mined at about 57 cents per ton, and costs from $1 to $1.05 per ton delivered at the furnace. The week's output of iron at the furnace of the Tennessee Coal, Iron, & Railroad Company at South Pittsburgh is the best showing ever made in the South. In the seven days the furnace made 705 tons, seven-eighths of which was No. 1 foundry iron.

WORK AND HURRY.

Mr. Herbert Spencer thought that the most valuable piece of advice he could leave us in departing from our shores was to be less restless—to work less and play more. Overwork was the besetting sin of Americans, according to that English philosopher, who spoke with the more feeling and the stronger emphasis on the subject because he himself was a victim of the very excess against which he warned us. He had come to the United States, in truth, with the hope of restoring tone to his nervous system, so shattered by indiscreet application to study that he was unable to sleep soundly.

Sensible people here, however, knew very well that working too hard was not an American vice. It is rare to find an American whose tendency to sin takes that direction. The men who complain most of overwork are usually those who are unfitting themselves for exertion by bad habits of self-indulgence. They could do their work without undue strain if they did not otherwise overtax their nerves.

But there is another very frequent case of nervous prostration. It is hasty and unmethodical labor, the habit of hurrying. But that cause, it seems, is commonly active in London no less than in New York.

The London *Lancet* warns the "city men," that is, the business men, that they are wearing themselves out with unnecessary hurry and bustle. It also tells physicians that they would do far more to prevent the spread of nervous disease if they undertook to cure this vicious mental habit, than they can hope to do by dealing only with the particular ills which come from it.

One of the chief characteristics of business life, the *Lancet* says, is to be always in a hurry. The moment a lad enters a business house "he begins to make believe to others, and too quickly to himself, that he is overwhelmed with work. The result is the formation of a 'mental habit' of hurrying, which before long becomes the keynote and motive of the whole life. It is the custom to write and speak as though commercial men were really as much pressed for time as they pretend to be. Now the simple fact is that all their haste and turmoil, prejudicial and often ruinous as it is, is artificial."

The bustling, hurrying man, as a matter of fact, is a poor worker, and accomplishes comparatively little in a day. Too much of his steam power is expended in kicking up a dust. The habit of hurrying and of feeling in a hurry is fatal to good work, and diminishes the amount of work a man can get through with. The friction is too great. So little of practical value is accomplished, despite all the superfluous expenditure of energy, that he cannot go home at night with the sweet consciousness of duty done, of a day's work completed. He has left too many stitches to be taken up.

The men who accomplish the most never seem in a hurry, no matter how much they have to do. Everybody must have observed that. They are not troubled for lack of time, for they make the most of the minutes by working in a cool, clear, orderly and methodical fashion, finishing each job properly, and not wasting their nervous force on trifles or expending it in bustle. They never complain of overwork. They are more likely to be hunting up new work to do, in order to give their faculties more varied employment and to exercise some which are not sufficiently used.

Too much work to do! The highest pleasure and greatest satisfaction are found in work only, and the more work a man has to do, if it is work to which he is adapted, the better he likes it. The men to pity are those who can get nothing to do, and those whose only business is to hunt for pleasure for itself—the fellows who have no other occupation than that of killing time. But we are also sorry for the men whose manner, as described by the *Lancet*, suggests a boiler worked up to the highest pressure and only saved from bursting by frequent letting off of steam.—*N. Y. Sun.*

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BOOK NOTICE.

"Monckton's Practical Geometry. Being a series of lessons beginning with the simplest problems, and in the course embracing all of geometry likely to be required for the use of every class of mechanics, or that are needed for instruction in mechanical schools. Illustrated by 42 full-page plates. By James H. Monckton." Wm. T. Comstock, New York, publisher. Price $1 free of postage.

AMERICAN CARS IN ENGLAND.

English conservatism has at last given away sufficiently, upon one road at least, to admit that the regulation American railway car is better adapted to its purpose than the old coach-body so long in use there. The Midland Railway Company, after an extended trial of the Pullman cars, has purchased them outright and will in the future use them as first-class cars, without charging an extra fare. And they also announce that hereafter all stock built for this road will be upon the car model, first and second-class alike.

The *Contract Journal*, of London, in commenting upon this new departure, remarks that no reasonable person will deny the advantages, as a vehicle, of the American car over the "narrow shelves upon which we English people sit like rows of goods glaring at one another in silence."

The same journal follows with a list of the dangers and annoyances that would be avoided by the new car, and regards the loss of privacy complained of by the few as being more than compensated for by the opportunity given in the American type to rid yourself of objectionable companions.

ANNUAL REPORT OF THE U. S. ENGINEER CORPS.

Major-Gen. Horatio G. Wright, Chief of Engineers, has submitted his annual report. He recommends the expenditure of $36,730,485, for the coming fiscal year, divided as follows: River and harbor improvements, according to estimates of amounts that can be profitably expended within the year, $32,113,385; examinations and surveys of rivers and harbors and contingencies for which there is no special appropriation, $150,000; seacoast and lake frontier defences, $3,693,000; construction of casemates and cable galleries for defences in Atlantic harbor, $200,000; purchase of torpedo material for storage for San Francisco harbor, $500,000; maintenance of Engineer School at Willet's Point, N. Y., $17,200; publishing results of geographical surveys west of the 100th meridian, $3,000; surveys and reconnoissances in military division and departments, $50,000.

Gen. Wright calls attention to the virtually defenceless condition of our coast against the attack of modern navies; and warns the people that even with the vast resources at their disposal they would lack time to improvise any adequate defences. Torpedo lines require for their effective working, lines of defence armed with rifled guns of size sufficient to combat heavily armored vessels; galleries from which to work the torpedo cables, and men trained in manipulating them. Guns of requisite calibre and in sufficient numbers could not be obtained from abroad in any sudden emergency, in time to be of service, and no such guns are now in this country, nor are our manufacturers prepared to make them.

In this connection the chief of engineers remarks that plans are already prepared for two double turreted iron forts, one for each shore of the narrows below New York; and he also suggests the application of the turret system to the harbors of Boston and other leading commercial cities.

It is recommended to increase the engineer battalion from the present force of 200 men to 752 men.

THE DULUTH WATER-WORKS.

These works have just been completed by the Duluth Water & Gas Co., under a franchise from the city granting it the exclusive right to furnish water for thirty years and gas for five years.

The system is supplied by two Blake pumps, each of a capacity of 2,000,000 gallons in twenty-four hours, with duplicate boiler power. Water is taken from Lake Superior by an in-take pipe 16 in. in diameter and 250 ft. long, with the inlet 50 ft. below the water surface. A 12-in. and a 10-in. forcing main connect the pumping station with the reservoir. This last is 245 ft. above the lake, and holds 750,000 gallons. It is about two miles from the pumps. An electric alarm-float notifies the engineer when the reservoir is filled. About nine miles of water mains are in place, and seventy-two hydrants are ready for use for fire purposes. The pressure upon the mains is between 80 and 85 lbs. per square inch.

The gas plant constructed by the same company is intended for the manufacture of "water-gas." It has a capacity of 25,000 ft. per hour. Six and one-half miles of gas-mains are laid, and 36 street lamps are to be used. One hundred and seventy services have already been put in.

Mr. Carroll E. Gray is the contractor and builder of both systems, and Mr. K. P. Corbyn Constructing Engineer.

THE ARLBERG TUNNEL.

The Arlberg Tunnel, the boring of which was completed Nov. 14, 1883, is a part of a new railroad system intended to shorten the distance between Western Austria and Eastern Switzerland. The new line is divided into two sections—the first running from Innsbruck to Landeck, the second from Landeck to Bludenz; the first sections is forty-five miles long and passes along the right bank of the Inn; its construction presented no extraordinary engineering difficulties. The second section has been more difficult and costly. It is thirty-five miles long, a mountain line throughout, and in the valley of Rosanna the gradient is one in forty. The valley of Panznau is crossed on a viaduct of three arches, each of 197 ft. span. The total estimated cost of this mountain section was $5,892,000.

At St. Antoine, on the Austrian side, is the entrance to the great tunnel, about 6½ miles long, at an elevation of 1,721 ft. above Landeck. The original location of this tunnel, as first surveyed by Gen. Nordling, was higher up the mountain, and consequently shorter; wide enough only for a single track and thus cheaper. But the Government forseeing the future importance of this work decided that the gradients should be reduced and the tunnel built at once for double track.

The work of boring the tunnel began on the Austrian side in June, 1880, and in September operations were began on the Swiss side of the mountain. The progress made in this latest tunnel is a striking illustration of the improvements made in machine drilling. The Mont Cenis Tunnel was bored at the rate of 3,637 ft. a year, the St. Gothard at the rate of 5,474 ft., and the Arlberg was pierced at the rate of 7,080 ft. per year. In matter of cost the Arlberg also has the advantage over its predecessors; for while the Mont Cenis Tunnel cost $2,000 per lineal metre—39½ in., the St. Gothard, $1,250, the Arlberg cost $750 the metre. The comparative shortness of the last named tunnel had much to do, however, with the relative cost.

The machines used at Mont Cenis and St. Gothard consisted essentially of a carriage mounting a series of drills driven by compressed air, furnished by the action of turbines at the ends of the tunnels. This system was used on the Austrian end of the Arlberg. The drills covered a space of seven square metres and made twenty to twenty-five holes at one time, each hole from one and a half to two metres deep. Each round of holes advanced the heading about one and a quarter metres. The air was compressed to "five atmospheres."

On the Swiss side another type of boring machine was used; the drills, each 70 millimetres in diameter, were driven by means of a water pressure of from 60 to 100 pounds per square inch. Six or eight of these drills were as effective as the twenty or twenty-five drills driven by compressed air; the holes were so much larger that equal results were obtained with the greater number of holes made by the other machines. The removal of débris after each blast consumed one-half of the working time in the Arlberg, and the workmen engaged in this labor were compelled by the gases and generally impure atmosphere to use sponges steeped in vinegar over their mouths and nostrils. These were found very efficient in neutralizing the poisonous air.

Under the terms of the contract, about 10 ft. per day was the progress required of the contractors. This rate was often decreased, especially in the tough rock found on the Swiss side of the mountain. Large quantities of water also frequently interfered with the excavation.

THE FORT WAYNE WATER-WORKS.

The fourth annual report of the above works is so presented that the information contained therein is valuable to the managers of any comparatively small water supply; giving cost of constructions, maintenance, etc.

Fort Wayne, Ind., has a population of 26,880. The works were constructed by the city in 1880; the system unites the direct Pumpage or Holly with a reservoir; the daily consumption for 1882-83 was 956,960 gallons; the mains are cast-iron, service pipes, lead.

The total length of mains laid, to April 30, 1883, was about 28 miles. The total cost of original construction to date, including $4,100 due R. D. Wood & Co., and $11,000 required to complete the reservoir, is $271,214.56; extensions to date cost $12,124.46, and the reservoir land cost $24,000, making a total of $307,339.02.

The revenue for the year ending April 30, 1883, was $15,109.96, made up principally of $13,424.33 from water rents, assessments and meter rates, and $1,076.33 from permits and service connections.

For maintenance in the year named: 581 tons of coal cost $1,938.96; the salaries of two engineers and two firemen, with some incidental expenses in overhauling machinery ($68.44) amounted to $3,488.44; waste cost $64.55; oils, $214.90; packing, $66.73; miscellaneous items, $47.33. The clerk's salary was $1,200, the inspector, $1,012.50. Implements and instruments cost $151.80; office expenses, including $240 for rent of Trustee's office, $404.93; street repairs, $47.50; engine repairs, $117.76; hydrant repairs, $36.35; engine-house repairs, $42.95; sundries and incidentals, $158.21; meter repairs, $33.04. From this it will be seen that the total ordinary cost of maintenance was $9,025.95.

The pipe-laying was done by contract; the 4-in. pipe at $0.14 per lineal foot; the 6-in., at $0.16; the 8-in., at $0.20; connecting 12 hydrants cost $24. In constructing the reservoir, 22,125 cubic yards of embankment cost $4,096.65.

The Pumpage service for the year cost as follows:

Expenditures for salaries, fuel and supplies	$6,033.46
Deducting value of coal and supplies on hand	594.00
Net cost of pumping service	$5,439.46

The average cost of pumping 348,912,843 gallons of water, was, per million gallons, $15.59; 3,115,568 gallons were furnished for fire purposes; a

the price above, this would amount to $48.56 in cost.

The pumps used are of the Holly type. The summary of results for the year are as follows:

Total gallons pumped	348,912,843
Daily average, 1882-83	956,960
Coal consumed, daily average in pounds	2 101
Ashes and clinkers, total for year in pounds	73,751
Average duty, lbs., raised 1 ft. per 100 lbs of coal.	60,454,061
Average Steam pressure	60 lbs.
" Vacuum	27 "
" domestic water pressure	55 "
" lift on pumps	29 ft.
Number of days of 24 hours run	333
Highest duty made during the years 1882-83	77,267,000
The engine house and connections cost	$12,607 57
The engines and boilers	30,899.19
Engine house furniture and fixtures	191 63

The pipe system as laid, including extensions to April 30, 1883, is summarized as follows:

24-in forcing main	4,200 L. ft.
24-in main	2,000 "
16 in "	5,170 "
12-in "	3,342 "
8-in "	31,462 "
6-in "	86,796 "
4-in "	12,935 "
Hydrant connections—6 in	2,192 "
6-in. Mathews public hydrants	132
6-in. Ludlow " "	64
6-in. Lowry " "	24
Private post hydrants	10
4-in. valves	24
6-in. "	83
8-in. "	28
12-in "	5
16-in. "	4
20-in. "	3
24-in. "	3

The total cost of the above 27.6 miles of distributive system, including pipes, specials, valves and hydrants, and laying pipes and setting hydrants, etc., was $161,491.74.

At present 818 rate-payers contribute $12,547.07; 23 meter consumers pay $2,500. The anticipated revenue from consumers for 1883-1884 is $20,047. The present average annual rate paid per service is $15.34.

POLES VS. UNDERGROUND CONDUITS FOR ELECTRIC LIGHT WIRES.

While in nowise opposed to electric light and telegraph wires *per se*, on the contrary very much in favor of their extension, we are nevertheless rejoiced to see any agitation pointing toward the removal from our city streets of the present unsightly and dangerous system.

In the case now on trial in this city of the residents of Twenty-fifth street *vs.* the Brush Co., some valuable testimony has been brought out relating to the annoyance and positive danger to the ignorant or unwary from the close proximity of electric light wires to the homes of the complainants.

Any one curious as to the number of wires for different purposes now enveloping in their meshes the business portion of New York has only to ascend to the top of the Mills' Building or any other elevated structure and see for himself; the only subject for wonderment is, Where do they all go to? The existence of these wires when a fire occurs is already recognized as a potent source of danger to life and to property. The fireman finds them interfering with his endeavors to rescue the one and protect or save the other; and he is himself liable to be tripped up by wires running over the roofs, or to receive a perhaps fatal shock from a severed light wire. Insurance rates are increased and the wires generally have developed into a first-class nuisance.

We do not for a moment side with the Chinese policy of exclusion, for we must have wires, and have many more than even now exist; but we do believe our cities should profit by the experience of other countries, and put these wires underground with the other systems of water and gas, now necessities of modern civilization.

The line must be drawn somewhere, the limit of the present method must be some time reached, so why not make a beginning before the cost of so doing becomes almost prohibitory? The new departure will be more expensive than the simple planting of poles and stringing of wires; this we admit, but it would also probably be cheaper to lay gas-pipes in the gutter than to bury them underground. The conditions and demands of the times have changed since Morse ran his experimental wires, and we should keep pace with the music of progress. Poles did well enough in the infancy of this invention; do well enough now along our railroads and country highways, but the requirements of safety and public utility demand other methods of treatment within our cities.

Paris, London, Brussels and other foreign capitals have already sunk the wires underground, where they belong, so it can not be put in defence that an adequate system is still lacking. The thing has been done, and done satisfactorily.

The companies upon whom the first expense would fall naturally object, and, as in the case mentioned when Wm. M. Evarts appeared for the Brush Co., have enlisted the ablest legal authorities to maintain their position. The Western Union dividends would, perhaps, be less if their wires were forced into a conduit; but in the end we believe they would be benefited quite as much as the public. Wires are added almost daily to the existing net, and these wires must be cared for by an army of employés; they are subject to all manner of danger to their efficiency; every fire destroys a number of them; each storm of snow or sleet causes extensive repairs; any evil-disposed person can tamper with them to the annoyance or positive injury of the company's clientage. All this would be avoided in a properly constructed and well-managed conduit system.

The argument may be advanced that there is no room under our streets, that, with the maze of water, gas and steam-pipes, drains and pneumatic tubes, now buried, the space will be wanting for any additional underground system. While this may be partly true in a few localities in New York, it is not the rule; and should the time come when this multiplicity of systems would interfere with a proper working, the remedy is at hand in substantial and roomy underground subways, such as are now in use in London and Paris.

THE EAST RIVER BRIDGE.

At the monthly meeting of the Bridge Trustees on Nov. 12, the following reports were submitted: The receipts for the month were $304,522, and the expenditures $293,480. The financial report of the secretary showed that the total receipts for the bridge were $15,236,767.54; expenditures, $15,157,723.99; on hand, $79,043.54; liabilities, $17,093.43.

The committee having in hand the arrangements at Chatham Square Station were not ready with their report. The contract to fit up "Lot No. 1" of the storehouses in the approaches has been let to Robinson & Wallace, for the mason work, for $35,439, and to the Keystone Bridge Works, for iron, for $13,189. Another locomotive was found necessary, the lowest bid for which was $4,155, from the Baldwin Locomotive Works.

The total number of foot passengers over the bridge for the 24 weeks since the opening was reported as being 3,964,700; vehicles, 38,110; passengers in cars for six weeks, 33,114. The receipts for the 24 weeks were $110,871; receipts from New York to Brooklyn for foot passengers, $21,773; from Brooklyn to New York, $17,874. The income from car passengers from New York to Brooklyn is not as large as from Brooklyn.

Chief Engineer Martin reported that work on the New York storehouses was well under way, and the ironwork had all been delivered. The viaduct on Sands street would be completed in two weeks. Mr. Martin said he expected to have heating apparatus put into the cars in a few days. There were three proposed methods of heating, and, after a trial of each, the best method would be adopted. The first method was by the use of chemicals in iron pipes. This method would cost $240 per car. The second method was to put up similar pipes filled with heated salt water, which would cost $175 per car; and the third method was to have stoves suspended under the cars, and surrounded by wrought-iron pipes, circulating hot water through the cars. This would cost $200 per car. The cheapest system for the twenty-four cars would cost $4,200, and the most expensive $5,760. This matter was referred to the President with power.

Mr. Martin said the electric lights were not giving satisfaction. The engines and dynamos were all right, but the lamps would not always light up when the circuit was turned on. Sometimes they would not light up until the inspector started them. Already ten lamps had been rendered useless by the magnets giving out. Sometimes the positive would not work and sometimes the negative. He was not in favor of accepting the lamps under present conditions. Mr. Martin said that it now costs two cents per passenger to run the cars.

The President said that he had received a proposition from the National Cable Railroad Company to operate a cable railroad on the bridge, the cost to be two cents for each passenger, the company to stand all the cost of transportation. On motion of Mr. Stranahan, the matter was laid on the table.

An impression prevails that the Chatham street elevated railroad station will be moved east. Mr. Witte said after the meeting:

"We must have more room to switch the cars at the New York end of the bridge, and we can only obtain this room by removing the station."

Mr. Stranahan said to a reporter:

"In regard to the extension of the switching facilities at the New York end of the bridge, it can only be done by extending the platform of the the bridge railroad across into City Hall Park. I think that will undoubtedly be done in time, and the Hall of Records will be swept away.

THE ATLANTIC CABLES.

The price of the two new Atlantic cables is stated to be about $7,000,000; this is, per mile, about one-tenth part of the cost of an average railroad. One firm, the Siemens Brothers, have contracted for the whole work. But three firms are at present engaged in this special branch of manufacture, in fact, two firms made and laid the ten Atlantic cables now in place. The business seems profitable, as the English papers give 20 per cent. dividends as resulting.

In making these cables the amount of materials used varies very little, though the type of cable differs with the opinions or experience of the company's engineer. The conductor is always copper, and the weight per nautical mile across the Atlantic is generally 400 lbs. Atlantic cables vary in length from 2,000 to 2,400 miles, and for a cable, of say 2,240 miles, 400 tons of copper would be required. The gutta-percha for insulating purposes will run about the same in weight as the copper wire; and the "homogeneous iron" wires run about one ton to the mile, excepting on the shore ends, where for about 15 miles from shore the cable will weigh from 12 to 18 tons to the mile. The "intermediate" cables sometimes extend 200 miles from shore, and weigh from 4 to 5 tons per mile. Jute is used for the packing between the gutta-percha "core" and the outer wires. These outer wires are in some cables separately covered with Manilla hemp, and the whole cable wrapped with jute tape and a compound of pitch and silica. In other types the "homogeneous iron" or steel wires have no separate coating, but lie close together; in others still each wire is separately covered with a compound of gutta-percha and some other materials secret to the trade.

During manufacture the cable is tested daily by the engineers of the buying company, and final payments are only made one month after the cable has been laid and found fully up to the specifications in the tests. Certain payments are made upon signing the contract, and monthly or weekly thereafter upon the certificates of the testing engineers as to length manufactured of each type.

It is thus evident that an order for an "Atlantic cable" necessitates considerable contract making, and, as stated, amounts to a very respectable sum. The iron used in the cables made in England generally comes from Germany. The labor in manufacture is a heavy item; 1,000 men, employed night and day, are required to fill an Atlantic order.

Steamers are now built especially for the work of cable-laying; the "Faraday," lately in this port, belongs to the Messrs. Siemens, and can carry an entire Atlantic cable, over 2,000 miles in length, in her tanks.

THE NEW TACOMA LAND COMPANY is preparing to construct water and gasworks for the growing town of that name in Washington Territory.

H. R. WORTHINGTON is putting in a half-million compound plunger-pump for the water-works at Chamberlain, D. T.

PERSONAL.

STATE ENGINEER BRITTON lately inspected the western branch of the Central Texas.

GEN. ROBBINS, State Surveyor-General of Idaho Territory, formerly of the Chicago *Inter-Ocean*, died in Tucson, Arizona, on the 14th.

MR. JAMES MCHENRY, the English capitalist and railroad financier, once so prominently connected with the Erie Railroad imbroglio, arrived in New York Nov. 12.

THEODORE HARTMAN was appointed, Nov. 12, Superintendent of the combined Little Rock & Fort Smith and Little Rock, Mississippi River & Texas Railways.

CHARLES E. GORHAM, of Chicago, the Western agent of the Pennsylvania Railroad Company, died in Cleveland on Tuesday night. He had represented the company's interest in that section for 35 years.

W. R. WOODWARD, late Superintendent of the Hannibal & St. Joseph Railroad, is reported to have been appointed General Manager of the Texas & St. Louis Narrow Guage Railroad, vice GEO. W. RISTEN, resigned.

OBITUARY.

COL. J. CONDIT SMITH died Nov. 8 at the New York Hotel. He was born in Troy, Morris County, N. J., in April, 1840. He was educated as a civil engineer and began his career in connection with the Illinois Central Railroad. Relinqushing his position on that road after several years' service he took large contracts, constructing among other works the levee at Cairo at the junction of the Ohio and Mississippi Rivers. He was engaged in the building of railroads until the outbreak of the Rebellion, when he entered the Federal service as Regimental Quartermaster, afterward becoming Quartermaster to Gen. Sherman's corps. Gen. Sherman appreciated his character and ability and held him in high esteem. When the war closed Col. Smith resumed the construction of railroads, building a number, the last being the Chicago & Atlantic Railway, the Chicago line of the Erie Railroad. At the time of his death he was Vice-President and General Manager of the Chicago & Atlantic Railway Company. He had been director in the New York Central, the Lake Shore, and other large corporations.

CORRESPONDENCE.

PAPER GAS PIPES.

PITKIN, COL., Nov. 9, 1883.

EDITOR ENGINEERING NEWS:

In your paper of Nov. 3, I see a notice of "Paper Gas Pipes." The last sentence, "The material being a bad conductor of heat, the pipes do not readily freeze," particularly excites my interest, as in the mountains here when work is going on in the winter, and with the thermometer far below zero, such a quality as a conveyer of water is most valuable. I would like to know where they are manufactured. If you will not think me taking too great a liberty, I would suggest that the name of the manufacturer would be a valuable addition to any such articles treating on useful inventions. Yours respectfully,

R. A. SKEELS,
U. S. Dept. Min. Surveyor.

[Our own knowledge is confined to the paragraph referred to, but we trust that this inquiry will bring out the information above solicited.—ED. ENG. NEWS.]

BRIDGE MODEL WANTED.

NO. 5 KAGA YASHIKI, TOKIO, JAPAN, October 16, 1883.

EDITOR OF ENGINEERING NEWS:

DEAR SIR: Will you or some of the readers of your paper be so kind as to inform me where I can have made a model of a 200-ft. span iron highway bridge, and about what it would cost?

Bridge to be a ten panel, double intersection Whipple truss, with vertical sway bracing.

Scale of model one-twentieth; and all parts wherever practicable to be made to scale. Working drawings will be provided. I should be greatly obliged for the information.

Respectfully yours,
J. A. L. WADDELL.

ENGINEERS' CLUB OF PHILADELPHIA,

ROOMS NO. 1523 CHESTNUT STREET, PHILADELPHIA, PA.

RECORD OF REGULAR MEETING, NOV. 3, 1883.

President Henry G. Morris in the chair, twenty-eight members and four visitors present.

Notes upon Roads, Streets and Pavements, by Mr. Chas. H. Haswell, were presented. Classification, grade and construction are first treated, and then special notes made with regard to macadamized, telford, gravel or earth, corduroy and plank roads, and asphalt, wood, block stone, rubble and concrete pavements. Miscellaneous notes upon road-making complete a very compact collection of data.

Mr. E. A. Geiseler read an illustrated paper upon Tides, and Newton's Theory of Them.

Mr. Allen J. Fuller presented notes upon the Effect of Frost upon Fire-plug Casings. He referred to a general impression that the freezing of the earth around fire-hydrants has a tendency to grip fast to the frost-jacket and lift it with the expanding or heaving earth, which he denied for the following reasons:

1st. The frozen earth slides on the surface of the frost-jacket, because its expansion is greater than that of iron.

2d. As the expansion of the earth must be in proportion to the intensity of the cold, so will it be greater above than below a given point, therefore, the first foot of frozen ground will have a greater upward movement than that which is below it, and the second foot greater than the third, etc. Thus it will be seen that the earth below a given point rises more slowly than that above and its friction is opposed to the one above.

3d. If this is true of feet it is true of inches, and of portions of an inch, therefore, there is a retardation movement throughout.

4th. The upward movement of the ground, the freezing being greatest towards the surface, and such movement involving a more complete fracture of the earth surrounding the frost-jacket, it follows that the friction is less at this point than that below it, and in consequence there is less power to move upward than downward.

Of course the above does not apply to any construction that the frost can get beneath.

Mr. Frederic Graff noted and described the form of wooden casing which had been successfully used in the early practice of the Philadelphia Water Department.

In response to the theory advanced in regard to the action of frost in raising the casings of fire plugs, and to the statement that if the base of a structure extended below the frost line it would not be lifted, Prof. Haupt remarked that he thought the theory was in part sustained by the fact observed by some of the district surveyors, and verified by the accurate measurements they were obliged to make, that fences moved bodily to the South and East in consequence of the action of the sun and frost upon the ground on opposite sides of them. He thought also that the deductions concerning the immobility of structures resting below the frost line was not fully sustained by the facts as, in the Northwest where ice forms rapidly, he had heard of numerous instances of piles, driven for bridges and extending some distance below the frost line, having been raised as much as five to six inches in a single night, and he conceived the action in this case to be similar in kind to that of piles driven entirely through solid ground, the only difference being in the *amount* of the resistance offered by friction and weight of pile. The water in freezing around the pile acts upon it as a gripper or vise, and the expansion of the various strata or laminæ of water as they become converted into ice act as levers to force up the pile.

The Secretary did not not consider the case cited by Prof. Haupt as parallel, as the so-called piles being driven through water and soft mud, were probably columns resting upon their bases and depending but little upon the frictional resistance of the material through which they passed. Therefore the expansive force upward of the freezing water would be opposed by little more than the weight of the pile, whereas in a fire hydrant casing or other proportional frictional resistance, as to cause the freezing earth to slide up the post rather than to lift it. It the ice could be supposed to act downwards upon the piles in question it is hardly likely that it would have forced them further home.

Prof. Haupt also exhibited a "History of the Manual Arts or the Inventions of Human Wit," published by Mr. Herringman, London, 1661, and read extracts therefrom describing the clepsydrae or ancient water clocks.

The Secretary read the following account from the *Mexican National* of Laredo, Texas, of a bridge construction by Mr. C. A. Merriam, Member of the Club, Asst. Supt. and Engr. F. Div. M. N. Ry: "On the 6th day of September (the anniversary of loss of bridge last year) the Mexican National Railroad bridge was carried away by high water. On Monday the 16th the first pile was driven for the new structure, which was completed on the 23d ult., and trains are now running regularly. This is pretty quick work, the erection of a bridge 600 feet long in seven days."

The Secretary narrated his experience on behalf of the club, and read extracts from correspondence, etc., with the Custom House, through the stupendous inscrutability of the management of which the transactions of the Society of Engineers of London, and of the Institution of C. E's of Ireland, are charged with duty, and all the other foreign societies upon the exchange list of the Club are admitted free.

HOWARD MURPHY, Secretary and Treasurer.

LIVERPOOL ENGINEERING SOCIETY.

The twelfth meeting of the Society was held on Wednesday, the 24th October, at the Royal Institution, Colquitt street, Mr. H. Brunall, president, in the chair. A paper entitled "Joints and Jointmaking" was read by Mr. T. Duncanson. The author, in opening the subject, described the various joints in use for pipes and the best modes of making them, under the heads of spigot and socket joints, flanged joints, screwed joints and soldered joints. He also treated of the circumstances in which each form of joint is most suitable and illustrated his remarks with diagrams and sketches. R. L. T.

Oct. 25, 1883.

SOME CURIOSITIES OF STEEL.

Eight master taps, or hobs, were made from the same bar of four-inch steel, each cut to a pitch of three to the inch, each scored, heated, hardened, and drawn to temper at the same time. Six hours after the tempering one of them "exploded," or at least cracked into three pieces with a report. The fractures give to the trained mechanical eye the appearance of good steel, and show no water cracks or other evidence of previous fracture. At the same establishment where this breaking occurred, one of its most important departments is the production of taps, reamers, dies, and similar tools. It has been abundantly proved that forged taps and reamers are inferior to those made direct from the sized commercial bar, not only in their resistance to torsion, but in the retention of their integrity under the exactions of hardening and tempering; the best taps are those which are turned direct from the bar.

There seems to be a tendency of forged steel, under certain forms, to return to the shape of the original bar. This is shown especially when the forging from a square bar is flattened. Sometimes a flattened piece will curve in the hardening as though its fibres had been stretched, and, when relaxed by the heat and again placed under tension by the cooling process, contracted toward the original condensed square form. A singular example was noticed recently. A plug gauge two and five-eighths inch wide and one and three-sixteenths inch thick was forged from a square bar, finished, and hardened. After hardening it was to be ground to exact size by a corundum wheel, when the ground side immediately swelled in the center almost enough to be seen by the unaided eye, but was quite apparent with the straight edge. The other face, from which the skin of hardening had not been removed, remained straight, but as soon as that had been ground it acted just as the other did and both the side faces were swelled, and so much so that the increase in thickness by the micrometer gauge was more than one-hundredth of an inch. On treating the edges a contrary result was produced; each edge face became concave, so that when the grinding was completed the plug had two opposite convex sides and two opposite concave edges. The plug was then annealed and redressed to truth; then re-hardened and reground with the same results as at first. A second time it was annealed, trued, and then case-hardened, but even then it continued its perversity, and it is to be kept as a curiosity as it is, unless it is decided to saw it in two to inspect its interior.

The most vexatious thing about these "queerities" is that no theory that bears the test of practice has, so far, accounted for them. If the "reason why" could be discovered the causes could be removed and the working of steel be made an exact and certain art. Still, there has been great progress in this direction during the last twenty years; the percentage of loss in hardening and tempering steel has been reduced to a very low figure. These improvements have been owing to the greater uniformity in the character of the steel produced as well as to the greater skill in its after manipulation. We may not despair of yet being able to make the production of hardened steel articles as even and certain as those from any other material.—*Scientific American.*

DIRECTIONS FOR LAYING SEWER PIPE.

EXCAVATION AND INCLINATION.—Commence at the lower end or outlet of the proposed drain or sewer, and make the trench of uniform, gradual and continuous inclination, and as great as attainable By distributing the whole available all over the total length of the drain a much better grade will be secured. A fall of 1 in 40 to 1 in 60 is desirable for pipes of 4 to 6 in. in diameter, and greater if attainable. A grade of 1 in 100 is the least that should be given to small house drains, in order to make them self-cleansing. Larger pipes require less inclination. After bringing the bottom of the trench to a true, uniform grade, cut out special grooves or depressions for the sockets. For the larger sizes of pipe, say all over 8 in. in diameter, excavate a very narrow trench in the middle of the ditch about 6 in. wide and 3 to 4 in. deep, so that the body of the pipe will rest firmly on the ground. This pipe will sustain the greatest amount of vertical pressure when it has a firm and uniform bearing at every point in its lower surface.

MODE OF LAYING.—Commence laying the pipe at the outlet with the sockets all facing *up grade*, fair and true to line, and upon foundations of assured stability. Do not lay boards in the bottom of the trench, on which to lay the pipe. The ends of each length of pipe should abut squarely and truely against the adjoining pieces, so as to present an absolute continuity and uniformity in the interior of the drain, particularly at the bottom line. The annular space between the spigot and socket ends of the pipe, should be completely filled with hydraulic cement mortar, paying particular attention to the bottom part of the joint, where the mortar should be pressed into it with the fingers.

CEMENT MORTAR.—A cement mortar, good enough for all ordinary use, can be made of one part hydraulic cement (Portland is the best) to two parts of clean, sharp sand, free fram loam or soil, and fresh made, as wanted for the work in hand. The mortar should be used immediately after being mixed, and not allowed to stand upon the mortar boards until it has set, and then be broken down, remixed or retempered, so-called. *Never* use any *lime* in the mixture.

CLEANING PIPE.—As the work progresses and each length of pipe is permanently fixed in place, the interior should be thoroughly cleansed and wiped out, and all projecting mortar or other substance carefully removed, so that the internal area of the drain will be left *absolutely unobstructed, smooth* and *clean* throughout its entire length, as otherwise the rough projecting points of mortar, when hardened, might catch any waste matter passing through the pipe, and gradually obstruct its discharge.

FILLING.—As fast as the filling is deposited in the trench (sand or fine dirt first), it should be thoroughly puddled or tamped, especially under and around the lower half of the pipe, and to such an extent as to render the subsequent settlement of the surface practically impossible.—*From Gladding, McBean & Co.'s Catalogue.*

REPAIRING A SUSPENSION BRIDGE.

The Suspension bridge, that link between the sister cities, Pittsburgh and Allegheny, which is traveled by hundreds of thousands of people weekly, has been in such a state of commotion, owing to the repairs being made upon it, that people have complained and growled at the inconvenience occasioned, and some of the papers have even said that the directors have been spending the money in order to cut down the reserve fund. All of which is an injustice to the bridge company in this instance. The work on the bridge is under the care of Mr. F. Collingwood, an old and experienced engineer, sent out by Col. Roebling, who built the bridge and is a large stockholder in it. This morning the writer was shown over the big green combination of iron and wood by Mr. Collingwood, who took pains to explain minutely what had been and what would be done.

It has been 24 years since the bridge was built, and in all that time the moorings of the cables have not been repaired to any extent. Col. Roebling thought it would be well to examine the wires and see what condition they were in, and it is well that such scrutiny took place, for the bridge was in danger of being ruined by the sagging and even by the breaking of the cables. There have been many changes in the manner of building bridges since this one was put up. These changes are improvements in every way, both as to the way in which the wires are protected and in the way they are surrounded at the moorings. The large cables, which are 7¼ in. in diameter, were closely surrounded at the moorings on each end by masonry which was concreted closely around the wires. Before the cables were so surrounded, they were covered with a preparation of boiled tar. Tar was once supposed to be an admirable protector of iron, but this belief was exploded long ago, and the result in the present case illustrates how injurious it is. The tar gradually, through atmospheric influences, changed into tar water, and this water was rapidly ruining the wire. The water contained chloride, carbonate, and other salts of ammonia, which ate the iron. Some pieces of wire were dotted with little holes, like small-pox pits, where the rust had gnawed away the material, and when the wires were uncovered and a strain put upon them they snapped like straws. Although each of the ⅛-in. wires should stand a strain of over 1,200 pounds they broke at 200. As soon as this state of affairs was discovered, Mr. Collingwood began to scrape the tar off and carefully overhaul each cable. Whenever a defective piece was found it was cut out and a new piece spliced in. The splicing was a delicate and difficult piece of work. It is easy enough to join the ends together, but it is not so easy to get just the right strain on the new piece. There must be no slack wires in the cable, of course, so each splice is put in with a grip machine, and the amount of strain is kept uniform by delicate tests. In one large cable 175 wires had to be spliced, in another 31, in another 71, five in another, and 31 in another, and three are not yet examined. It is very tedious work scraping each wire, as only a few men can work at a time. There are 600 of these wires in the big cables and 200 in the small ones, so that the amount of work can readily be seen. After the wires are scraped they are covered with a coating of linseed oil, which is allowed to dry, and a thorough application of white lead is given. Then the wires are drawn together by bands of small wire 7 in. apart, and the wrapping goes on. The wrapping consists of wire $\frac{1}{16}$ in. thick, and it takes 300 ft. of this wire to a foot of cable. A coat of ordinary white lead and coloring finishes the work.

One mistake made in building the bridge was in putting the masonry around the cables at the moorings so that they could not be examined. The masonry has been all removed and a bricked tunnel built which is water tight and is provided with iron water shedders and covered by iron plates, which can be lifted when it is necessary to repaint or repair the cables in future. Where the cables pass through the woodwork holes have been made so that all parts of the big wire can be reached at any time. The building on the lower side of the Pittsburgh end of the bridge has been torn down and a new office of Philadelphia brick is to be built. This was rendered necessary by the fact that half of the foundations of the building rest on the bridge abutment and half on made ground. The latter half sunk so as to cause a large crack in the office wall and make it dangerous. It is exactly the same case with the toll house on the Pittsburgh side, and it will be replaced. A good deal of stone work on the pier nearest to Allegheny had to be replaced as the sandstone had decayed. The decayed stone was put in the pier in 1834, and was part of the old bridge which was enlarged and built upon when the present bridge was constructed. The nosings of the pier were also renewed. The work is being done entirely by Pittsburgh mechanics under Mr. Collingwood's direction. The cost of the repairs will not be over $10,000 or $15,000, and they will not be completed for a couple of months. Mr. Collingwood says that the flooring needs repairing, but the company has no seasoned wood on hand at present. He says it takes 10 per cent. yearly of the cost of a large bridge to keep it in good condition. None of the repairs were made necessary by the fire of two years ago, strangely enough. The bridge has safely supported a load 22 tons on one wagon, but the engineers advise the directors to refuse to allow more than 12-ton loads to pass over.—*Pittsburgh Telegraph, Oct. 1.*

BROOKS AS SEWERS.

When a natural watercourse traverses a town, and its banks become built upon, the easiest way of getting rid of filth and house wastes is to throw them into the stream. Every man's instinctive impulse is to get rid of what annoys him, and not to mind how his neighbor will be affected. After a while, when the watercourse has become sufficiently nasty, the people come to a realizing sense of what they have brought upon themselves, and then try to devise a remedy. In this they begin usually at the wrong end. They look on the stream as creating the nuisance, and don't consider that it is their abuse of the stream that is the source of the trouble. So they go to work and cover the stream up, and call it a sewer. What is the result? Simply that the stench of the foul matter in the old channel is bottled up somewhat, to be vented through every manhole, every inlet and every house drain, and probably do more real injury than when the rotting filth was exposed to the air and the sun, and diffused its aromatic out the whole atmosphere.

The channel of a small natural stream through a town or village ought never to be converted into a sewer for house wastes. This will strike a good many people as an odd doctrine, but still it is sound doctrine. The functions of a natural stream and of a sewer are so diverse that one cannot be made to do duty for the other.

A natural watercourse serves for the drainage of the land all along its course. Its banks cannot be made water tight without obstructing the natural progress of the water in the soil and backing it up and retaining it where it ought not to be retained. A sewer, on the other hand, is intended to carry off foul matters which must be gotten rid of as quickly as possible, and the channel for conveying them must be absolutely impervious, so that nothing can soak through it to the soil. As the level of the water in the soil rises and falls with the season and the amount of rain, an open-jointed or pervious channel would sometimes admit water from the soil and sometimes permit fluids flowing in the channel above the level of the ground water to flow out, and thus pollute the soil and the air in the soil.

Again, a natural stream draining a considerable territory is subject to great variations in its volume. A channel to carry its extreme discharge in floods must be many times larger than can ever be necessary for the carriage of the greatest amount of sewage that can be brought to it. A large channel is not suited to the rapid removal of a small flow of filthy fluids, and, moreover, costs a great deal more than a sewer of the proper size. Even if the large channel for a fluctuating stream is built through a village, the sewage from the houses should not be turned into it, unless the minimum volume of the natural flow in the dryest seasons is large enough to keep the channel thoroughly scoured. There are a good many small towns which have for years gotten along without sewers and have arched over natural water-courses running through the heart of the town, but are now impelled by the "sanitary revival" to construct sewers for removing household wastes. The first impulse is to utilize the covered streams to save the expense of constructing a few hundred feet of sewer. They should be very careful how they proceed. It is better to spend a little more money and be safe, than to economize in first cost and spend ten times the saving in doctor's fees and undertaker's bills.—*Sanitary Engineer.*

HIGH STEEPLES.

The following are the heights of a few of the tallest steeples:

	Feet.
Pisa, leaning tower	179
Baltimore, Washington Monument	210
Montreal, Notre Dame Cathedral	220
Boston, Bunker Hill Monument	221
Montreal, English Cathedral	224
Paris, Notre Dame	224
Bologna, leaning tower	272
Cairo, minaret of Mosque of Sultan Hassan, highest Mohammedan minaret in the world	282
New York Trinity Church	284
Florence, Campanile, or Giotto's Tower	292
Lincoln, Cathedral	300
Washington, Capitol	307
Venice, Campanile	322
New York, St. Patrick's Cathedral (to be when completed)	330
Utrecht, Cathedral (formerly 364)	338
Florence, Cathedral	352
Milan, Cathedral	355
London, St. Paul's	365
Brussels, Hotel de Ville	370
Lubeck, Cathedral	395
Antwerp, Cathedral	402
Amiens, Cathedral	422
Hamburg, St. Michael's	428
Landshut, St. Martin's	435
Cairo, Pyramid of Chefren	446
Vienna, St. Stephen's	449
Cairo, Pyramid of Cheops (original height 480)	450
Rome, St. Peter's	455
Rouen, Notre Dame	465
Strassburg, Cathedral	468
Hamburg, St. Nicholas	471
Cologne, Cathedral	515
Washington Monument (to be)	553

THE LATEST BRIDGE OVER THE MISSOURI.

The Omaha *Herald* gives the following description of the new bridge over the Missouri River at Blair, Neb., which has been built by the Missouri Valley & Blair Railway & Bridge Co., and will be used by the Sioux City & Pacific road:

On the section of the river where the new bridge is located, the banks are five to ten or more miles apart, the country between them being the usual Missouri River bottom land. For a distance of about fifty miles the river does not strike either bluff, but wanders back and forth in the bottom lands with no fixed banks to correct its course. The proverbial instability of the Missouri River is nowhere more prominently felt than here. The commercial necessities of the case required that the bridge should be built, and the physical conditions of the situation made it necessary to give the river an artificial stability which nature had not given it. The work of controlling the river has been quite as important as the construction of the bridge, and has involved a vast outlay of time and money. The first examinations were made in the winter of 1881-82, by surveys and borings, which showed that solid limestone rock existed about 50 ft. below the assumed low-water level, well calculated to sustain the piers of a bridge. A plan for the rectification of the river was decided on, and it was decided to erect a bridge 1,000 ft. long to protect the shore by rip-rap and mattress work until it should be as stable as a rocky bluff, and to close all slough channels on the

east side so that the river would have no room for a width greater than that found at the stable places below. This bridge is the eleventh constructed across the Missouri River. At several others important rectification works have been required, but it is the first bridge located at a place which may be described as absolutely unstable, with no permanent shore line on either side. This work was done successfully, though seriously interrupted at times by heavy floods, and the banks are now in such shape as to preclude any possibility of washing. On the east side 30,500 tons of rip-rap stone and 3,600 cords of brush have been used. The dyke was built of willow mattress work, wired together and heavily weighted with stone. The revetment on the west side was begun in the summer of 1882, though but little was accomplished until 1883. Up to date 59,000 tons of stone and 7,100 cords of brush have been required in this plan. The river has been held at the line selected, and the fact that the channel has been scoured out to the limestone rock proves that this protection will be permanent.

The bridge proper consists of three through spans of iron and steel resting on four masonry piers, with a short deck span at each end. The through spans are each 330 ft. long between centers of piers, and the distance from center to center of the east and west piers is 999 ft. The length of the permanent iron structure is 1,270 ft. The lower chords of the spans are placed 50 ft. above high water, thus giving free passage to steamboats without a draw. The four piers are built of yellow sandstone, the cut-waters of the two channel piers being of granite. Each of the four piers is founded on a timber caisson 54 ft. long and 26 ft. wide, sunk to the rock below by the plenum pneumatic process, and filled with the best Portland cement concrete. Air pressure was put on the first caisson on Nov. 22, 1882, and the last foundation was completed April 19, 1883.

The superstructure consists of three 330 ft. through spans and two short deck spans at the ends. It is proportioned to carry a train of indefinite length formed entirely of the heaviest class of locomotives now in use. These three spans contain 1,465,000 pounds of wrought iron and 880,000 pounds of steel, besides 48,000 pounds of cast iron in pedestals, etc. The deck spans are 110 ft. long, the shore ends resting on inexpensive iron cylinder piers of the Cushing pattern; each span is divided into five panels of 22 ft. each, with an addition of a panel or iron floor beyond. These deck spans contain 250,000 pounds of iron and steel. The iron and steel work was fabricated and erected by the Keystone Bridge Co., of Pittsburgh, Pa., from detailed plans prepared by the Engineer of the Missouri Valley & Blair Railway & Bridge Co. The floor beams and track stringers are of iron, and on them is laid a safety floor of heavy oak ties, placed only 6 in. apart, with heavy angle-iron guard rails, with foot walk and light hand rail on each side.

The east approach is about two miles long from its connection with the old Sioux City & Pacific track to the eastern end of the iron work. When completed it will consist entirely of an earth embankment; but to save time the embankment, the 3,000 ft. next to the bridge, has been built in the form of a temporary timber trestle. The completion of the bridge renders access easy to the clay bluffs on the west side, and the whole trestle will be filled at once to a safe height above the high water, and the whole of it will be replaced by an embankment before the life of the timber is spent.

The west approach is about 1¼ miles long from the connection with the Sioux City & Pacific track near Blair to the west end of the iron work, the distance from the edge of the bluff to the river being about half a mile. There is a trestle on this approach about 1,000 ft. long over Fish Creek, the old Sioux City & Pacific track and the intermediate ground. Between this trestle and the bridge there is an embankment from 40 to 50 ft. high, which has been built by steam-shovel work with clay taken from the west bluff. It was expected to have this embankment entirely completed before the opening of the bridge, but a serious settlement occurred at a place where it crossed an old slough, the total settlement being apparently as much as 30 ft., while the ground on both sides has been forced up 14 ft. high. Boring at the sink showed a great depth of mud and clay, though the bed of the old slough was scarcely visible on the surface. The bank has been brought to grade and has acquired a permanent stability, but the extra amount of material in this work has prevented its completion in season for the bridge, and required the building of a short piece of trestle-work at the east end of the bank. The total outlay so far has been about $800,000, and it is estimated that $200,000 more will cover the cost of work yet to be done.

THE DULUTH WATER-WORKS have been tested and accepted by the town authorities. The works, including 8 miles of pipes and a reservoir, were built by the Duluth Water & Gas Co., capital stock, $200,000; Consulting Engineer, Mr. H. H. Harrison, of the Stillwater water-works.

NEWS OF THE WEEK.

THE EMPIRE IRON COMPANY, limited, has been formed to manufacture, sell and deal in tubes, flues and pipes of steel or wrought iron of every nature and description; to buy and sell the above things in its own name or through agents; to act for others as agent or otherwise in the purchase and sale of such merchandise, and to buy, sell or lease manufactories, plants, lands and mills for purposes approved by its board of directors, etc. The capital stock is $100,000, divided into 1,000 shares. Principal office, New York City. Operations to be carried on in New York, New Jersey, Pennsylvania, Illinois, Missouri, Ohio, Massachusetts and wherever the company shall procure rights and lands. Incorporators, William H. Cromwell, Charles H. Cromwell and Albert S. Moore, of Brooklyn; William J. Curtis, of Summit, N. J., and George C. Comstock, of New York.

A FLORENTINE ENGINEER.—A correspondent of the Chicago *Inter-Ocean*, writing from Sioux City under date of the 31st ult., says:

Superintendent Jackson, of the Chicago, Milwaukee and St. Paul Railway, is in receipt of a foreign postal from J. Hese, a civil engineer of Florence, Italy, who expresses himself as highly interested in what he aptly terms the "novel and interesting method for removing masses of earth" now being employed by the above road in cutting down the bluffs at this point, and making a secure roadbed around them by the hydraulic process. The Italian engineer, who is a contributor himself to *Giovrale dei Levois Publiceen*, the Florentine journal of public works and railroads, states that he had read of the work at Sioux City in the *Scientific American*, which had copied an article from from the Sioux City *Journal*, and he writes to learn further particulars. The work in question, which is progressing rapidly under Superintendent Jackson's supervision, is designed to insure the road against any further danger of a landslide, such as occurred during the present year on the bluffs. The railroad track is to be moved 40 ft. nearer in from the brow of the bank overlooking the Missouri, and the bluffs, one of which is 165 feet high, have already been cut down and back as much as 75 ft. The earth, which easily yields to the streams of water directed against it, is a bowlder clay, as it may be called. The interested Florentine proposes to enlighten the Italian railways, promising, in his closely written postal, to give them the benefit of the experience of the American road in surmounting an obstacle it required some skill to cope with.

A NEW CURRENT METER.—One of our exchanges gives a short account of a new and interesting appliance, proposed by a Mr. L. d'Auria, for determining the mean velocity of the water at any vertical in a stream. The apparatus consists of a scow or pontoon, to be moved in the desired place; a pole with a pulley near each end, carrying an endless cord; a light ball, and a species of net or grillage. The pole is thrust to the bottom alongside the scow, at a point where the velocity is to be gauged, and the ball is lightly attached to the cord by a string, so as to be disengaged by a moderate pull when it reaches the pulley at the bottom. The time of the disengaging pull is noted, and also the time of the appearance of the ball at the surface. As the floating grillage has previously been moored over this place, the ball is caught at the point of rising, and the horizontal distance of this point from the pole measured. Hence are known, upon measuring the depth, the two coordinates of the point at the surface from the bottom of the pole. Mr. d'Auria proposes to weight the ball until it shall be one-half the heaviness of water, and deduces some equations to prove that the ball rises with a practically uniform velocity. He observes that, for a depth of 30 ft., from which such a ball would rise in about 11 seconds, and a mean velocity of current of 4 ft. per second, the ball would travel horizontally about 44 ft.

ELECTRIC LIGHTS SET GAS ON FIRE.—An automatic fire alarm sounded at 6.10 o'clock last evening from the store of Rogers, Peet & Co., No. 569 Broadway, and this was followed immediately by an alarm from the street box in front of the Metropolitan Hotel. When the firemen arrived the fire was out and their services were not required. The cause of the alarm was the ignition of an accumulation of gas in the show window of the firm at Prince street and Broadway. While arranging the wires connected with the dynamo by which the electric lights in the store are supplied yesterday afternoon a row of gas-jets running around the top of the windows were lighted and were burning for about two hours. At 6 o'clock the electric lights were started, and the gas in the show window was turned out. Ten minutes later there was a puff of fire in the window, which cracked one of the plate-glass panes and set fire to some of the goods. The current of electricity was switched off and the fire extinguished with a pail of water. The rise of temperature in the window had set off the automatic alarm, and the street alarm was sent by some one in the hotel. The damage by the fire was very slight. It is believed that a quantity of gas which had escaped from a leaking pipe and had accumulated in the window after the lights were put out ignited from the electric light and caused the fire.

CAMDEN IRON WORKS.—Articles of incorporation have been filed in the Clerk's Office of the County of Camden by the Camden Iron Works, with a capital stock of $400,000, $300,000 of which being set down as subscribed. The works of Jesse W. Starr, Sr., have been purchased, an order having been granted in the United States District Court at Trenton permitting Starr to dispose of his property and vacating the order placing the iron works and other assets in the hands of his creditors. All claims against the works have been arranged and they will go into operation, it is thought, in a few weeks, as large orders have been received. The chief production will be foundry iron and machinery. Branch offices will be opened in Philadelphia and New York. The copartnership is limited, to expire, by the articles of incorporation, on Sept. 30, A. D., 1930. A majority of the stock is held by the Wood Bros., proprietors of the large iron works on Ridge Road, Philadelphia.

POSTAL RATES 90 YEARS AGO.—Now that the two-cent postage law has gone into effect, the following provisions of the first law of Congress on the subject will be read with interest:

Feb. 20, 1792, was the date of the first act fixing rates of postage on domestic letters, and established the following rates, to take effect June 1, 1792:

Act Feb. 20, 1792, section 9, by land: For every single letter not exceeding 30 miles, 6 cents.

For every single letter over 30 miles and not exceeding 60 miles, 8 cents.

For every single letter over 60 miles and not exceeding 100 miles, 10 cents.

For every single letter over 100 miles and not exceeding 150 miles, 12½ cents.

For every single letter over 150 miles and not exceeding 200 miles, 15 cents.

For every single letter over 200 miles and not exceeding 250 miles, 17 cents.

For every single letter over 250 miles and not exceeding 350 miles, 20 cents.

For every single letter over 350 miles and not exceeding 450 miles, 22 cents.

For every single letter over 450 miles, 25 cents.

For every double letter, double the said rates.

For every triple letter, triple the said rates.

For every packet weighing one ounce avoirdupois, to pay at the rate of four single letters for each ounce, and in that proportion for any greater weight.

BUSINESS PROSPECTS.—A few days ago, in a conversation with a very influential gentleman whom he knew to have nothing to do with Wall street speculation, Jay Gould said:

"I expect to see a great improvement in all branches of business early next year. The settlement of the year's accounts will continue to keep things uncertain, and there are, of course, some more failures anticipated between now and the close of the year. But after that I expect to see things greatly improved. There are over a hundred millions of dollars lying idle in the trust companies. This mass of money awaits a chance for investment, and will come out as soon as an improved feeling has been established. The railroads are all doing a good business, and I have no doubt that their securities will soon be better appreciated."

THE COMING WORLD'S FAIR IN NEW ORLEANS.—Extensive preparations are being made for the World's Industrial and Cotton Centennial Exposition which is to be opened in New Orleans in December, 1884. The fair is to be held in the City Park of New Orleans, which is very easy of access by both land and water, and the main building will cover about twenty-eight acres. Col. F. C. Morehead, the Commissioner-General of the Exposition, who is now in this city, says that in one sense it is an outgrowth of and will be a sequel to the Atlanta fair of 1881. It is to be not only a world's fair in which all the nations are invited to take part, but also a special exhibition of the natural resources and industries of North America from Canada to Mexico. Exhibits are also expected from the States of Central and South America. Furthermore, Col. Morehead says it is to be a celebration of the centenary of the first exportation of cotton from this country. The first cargo consisted of eight sacks containing not over 200 pounds of cotton apiece, and was sent from Charleston in 1784.

The National Cotton Planters' Association has invited the Governors of all the States in which cotton is either produced or manufactured to send delegates to its fifth annual convention in Vicksburg next week.

OTTAWA, WADDINGTON & NEW YORK RAILWAY.—A meeting of the shareholders of the Ottawa, Waddington & New York Railway and Bridge Company was held in the Russel House, Ottawa,

at noon on the 9th for the purpose of electing directors. There was a good attendance of provisional directors and stockholders. The following were elected directors: T. B. Anderson, Ottawa, president; Dr. Hickey, M. P., Dundas, vice-president; W. P. Carman, New York, treasurer; A. Keefer, Ottawa, secretary and assistant-treasurer; Charles Odell, Montreal, chief engineer; J. W. Imlay, Ottawa; W. Montrose, New York; Hon. R. H. Shannon, New York; G. Nixon, New York. It is learned that the president has been between England and New York for some months in the interest of the railway, and had several interviews in both places with railroad men and capitalists. Two construction companies offered to take the bonds of the company and build the road and the bridge as soon as the company was organized, and unless something unforeseen arises it is expected that the contract will be let and bonds issued as soon as the arrangements for connecting with the New York and Canada Bridge Company can be effected, the latter company having been chartered to construct the bridge in connection with this railway across the St. Lawrence.

OPPOSING A METRIC SYSTEM.—At the rooms of the American Society of Civil Engineers, No. 127 West Twenty-third street, on the 15th, was organized an auxiliary branch of a society which has for its object the retention of the Anglo-Saxon system of weights and measures. Thomas F. Rowland was elected President and Clark Fisher Vice-President. The main office and central society of the organization is at Boston and another branch is at Cleveland, Ohio. That formed yesterday is to include the States of New York and New Jersey. The society was organized in 1879 in Boston, and the late President Garfield was at one time its President, and it is said that it was through his instrumentality that a bill to make a national standard of the French metric system of of weights and measures was defeated in Congress.

WORK ON THE LEVEES—NEW ORLEANS, Nov. 15.—Major Amos Stickney, of the United States Army in charge of the Government works, reports that at the mouth of Red River a rise in the stage of water has given needed relief to navigation. During the summer extreme low water interfered with the work of dredging. A survey is in progress to determine the question of laying a brush dam in the mouth of the Atchafalaya to prevent further enlargement of that stream. Work on the levees, which are being constructed under the direction of Major Stickney for the Mississippi Commission, has been much delayed by the scarcity of labor. The approach of colder weather has aroused the laborers to the necessity of going to work, and, therefore, more men are available and better progress is made in building the levees. The lines from Atchafalaya to Red River Landing, from Green's to Fairview, will soon be completed, leaving only three levees in the district unfinished. At Carrolton Bend the work of protecting the bank by laying brush mattresses has been commenced and 75 feet of mattress laid. Operations have been going on slowly so far, but good results are expected.

A NEW ELECTRIC LIGHT COMPANY.—The certificate of incorporation of the Southern Electric Light Company, whose main purpose is to supply cities and towns in the Southern States with electric lights, was filed in the County Clerk's office on the 15th. The capital stock of the new company is $500,000, divided into 5,000 shares of $100 each. Its corporators are William J. Cahoone, Oscar King and Henry C. Elliott, of this city, who, with John C. Calhoun, of Arkansas; James Lingan, of Louisiana; Patrick Calhoun, of Georgia; J. P. Hodgeson, of Texas, and Edward C. Hancock and James H. Shorter, of this State, form its Board of Trustees for the first year of its existence.

THREATENED WATER FAMINE IN WATERBURY.—WATERBURY, Conn., Nov. 15.—The water scarcity continues. The rainfall to date is seven inches less than it was last year. In order to re-enforce the reservoir, containing about three weeks' supply, the Commissioners have dammed Mad River, a considerable stream, and placed a powerful steam pump at the dam capable of forcing 1,000,000 gallons into the supply main in 24 hours, lessening the drain upon the reservoir by so much. The arrival of cold weather brings the city face to face with great danger. The most rigid economy must be exercised, and everywhere the consumption of water has been reduced one-half.

CONCERNING the Cape Cod Ship Canal the Boston *Advertiser's* correspondent says: "In no case has any effort been made to reach the depth of the contemplated canal. The marsh turf, cut into cakes by a hundred shovels, is being ranged day by day in a pyramid-shaped embankment of some thousand feet in length by the edge of the canal. The work now in progress confines itself to removing grassy marsh turf for the greater convenience of subsequent dredging. The force employed has numbered 451; it cannot now exceed 150. On the 26th day of October last scow dredging machines were on the ground. Only one excavator and two lighters, in a more or less sound condition, remain. That money is being lavishly spent can hardly be the case. Nor can it be said that all moneys have been expended wisely. But that considerable outlay has been made for a canal, and still continues to be made, a glance at the works in Scusset harbor is sufficient to establish."

HELL GATE TO BE BRILLIANTLY ILLUMINATED.—The iron for the new Government lighthouse at Astoria is on the ground, and the foundations are now building. The lighthouse will be erected at the extreme end of Hallett's Point. It is to be built entirely of iron, and will be 250 ft. high, surmounted by a large dome. The light will be furnished by electricity, through a powerful engine in the building, and there will be six electric lights, having altogether 20,000 candle power. An elevator run by steam will take passengers to the top of the lighthouse. The light will be seen from Sandy Hook and up Long Island Sound beyond New Rochelle. It will render the passage of Hell Gate as easy by night as by day. It will not be ready for use before next spring.

MAIN SEWER.—At a city meeting held recently the citizens of Norwich, Conn., voted an appropriation of $37,250 for constructing a main sewer at Greenville, under the combined system, in accordance with the recommendation of the Common Council.

NEW FEDERAL BUILDINGS.—WASHINGTON, Nov. 12.—The Supervising Architect, in his annual report recently submitted to the Secretary of the Treasury, says of the proposed new Post-Office Building at Brooklyn, N. Y., that the amount set as the limit of expenditure ($800,000) for the securing of a suitable site and the erection of a building large enough for the purpose is totally inadequate. He says that the report of the Commission appointed to examine property for sale as a site for the building has been submitted and awaits action.

With respect to the Post-Office and Custom-House at Albany he says that the estimate made for the completion of the work was entirely too low, and that a further appropriation will be required. He reports satisfactory progress during the past year, with an expenditure of $107,795, which leaves a balance or $9,720 available for this work. He says that, although the building will be in condition to be occcupied by December next, the painting, concreting of basement, construction of elevator, laying of sidewalk and approaches cannot be completed without a further appropriation.

NEW RAILROAD.—Efforts are being made to secure the building of a railroad from Toyah to Fort Davis, Tex., to connect with the road to be built from Fort Davis to Marta. This will be an air-line to Presidia del Norte, thus shortening the route to Mexico from the North and East, reaching the Concho Valley and one of the richest stock and agricultural districts in Mexico.

WEST SHORE TRACK COMPLETED.—SYRACUSE, N. Y., Nov. 13.—The last gap in the track of the West Shore road, between New York and Buffalo, was closed to-day, and the line is now completed between these cities. The trains will be running between New York and Buffalo on December 15. The track is in fine condition between Syracuse and Buffalo.

GIFTS FROM GEN. GRANT.—HARTFORD, Conn., Nov. 14.—Two machine guns have just been completed at Pratt & Whitney's works in this city for Gen. Grant as presents to the Viceroy of China and the Mikado of Japan. The guns are Pratt & Whitney's improvement over the gun once known as the Gardiner gun. The guns of the model after which they are made have a Government record of 505 shots a minute, and have been fired at the rate of 700 shots a minute and 5,000 shots in 13 minutes 26 seconds.

No intelligent reader can fail to be interested in the contents of the *North American Review* for December. The question of the telegraph has the place of honor in the number, Gardiner G. Hubbard pointing out the great advantages that would result from the proposed "Government Control of the Telegraph," and showing from the experience of several European countries the benefits to be derived from the incorporation of the telegraphic with the postal service. Prof. J. Lawrence Laughlin, of Harvard University, shows the "Evils of the Sub-Treasury System," in its absorbing and withholding from circulation the specie that is constantly needed to insure stability in the world of finance. "The Day of Judgment," by Gail Hamilton, is a caustic review of the less amiable moral traits of Thomas Carlyle. Henry George writes of "Overproduction," an idea which he declares to be preposterous, unless more wealth is produced than is wanted. Gen. W. B. Franklin sets forth the views of naval and military experts as to what is absolutely needed in the way of organization, forts, ships and war material, to insure the "National Defense." An article on "Railroad and Public Time," by Prof. Leonard Waldo, of the Yale College observatory, explains the system of uniform time standards now being introduced into the railroad service of the United States. Finally, there is a discussion of the question of "Morality without Religion," by F. A. Kidder and Prof. A. A. Hodge, of Princeton College. Published at 30 Lafayette Place, New York, and for sale by booksellers generally.

STANDARD TIME.—Much interest is manifested in the position taken by the Illinois Central Railroad on the subject of the new standard of time. The refusal of that corporation to adopt the new time means much, as it controls a new line from Chicago to New Orleans and out into Iowa and Wisconsin, and such a trunk line would have a vast influence on the action of numerous connecting roads.

A NEW JERSEY ROAD.—It is stated that the Long Beach Railroad Company, under the control of the Pennsylvania Railroad Company, has purchased the Tuckerton Railroad, running from Tuckerton Station to Whitney's Junction. It is said that the purchase is a part of a scheme to construct a line to extend from Barnegat City the entire length of Long Beach to Absecom, where it would connect with the Camden and Atlantic Railroad. About fifty miles will be required to complete the line. The new line, which will be controlled by the Pennsylvania Railroad, will be completed by June 1, 1884.

THE Phœnixville tunnel of the Schuylkill Valley Railroad will require 175,000,000 bricks.

RAILWAY WORK IN IOWA.—Work has been begun on the La Crosse and Cresco in Howard County. There is a great deal of rock cutting between Charles City and the Mississippi. J. H. Roach of New York will have the general supervision. The road runs from St. Marie to Kansas City.

THERE will be another bridge built by the Chicago, Burlington & Quincy, across the Mississippi at Offerman's Island.

THE Central American (Guatemala) line, as at present planned, will be 450 miles in length, but in some places the expense will be very heavy. Among the appointments of the engineers and surveyors are those of Mr. S. Miller, Mr. Hazard and Mr. Parker,

NEW ROAD IN NEW HAMPSHIRE.—A road will soon be begun from Blood's Crossing to Mount Vernon. Length, 13 miles.

THE LEHIGH VALLEY IMPROVEMENTS.—Work has progressed very rapidly on the Tifft farm. The canals, trestles and wharves will cost in the aggregate something like a million of dollars, and when completed Buffalo will have the best facilities for handling lumber and coal. The contractors have for the past few months averaged over 50,000 feet of earth per month, and have already completed the excavating for the canal on the side. The work on the other two canals is over half done.

A NEW diagonal road is to be built in Northern Iowa. Mr. F. A. Rozine, of Charles City, has disposed of the bonds of the company.

THE Youngstown (O.) Electric Light Company has been organized; capital, $60,000.

NEW ROAD IN CONNECTICUT.—A survey is being made of a line of railway from New Canaan to Danbury. The line will pass through Ridgefield village to Danbury. This is a continuation of the New Canaan and Stamford road. The new line will be double tracked.

A NEW road will be probably built in Tennessee, from Sparta, White County, to the Bon Air coal fields. The surveys have already been made.

THE Shousetown, Clinton & Frankfort Railroad (Pa.) is nearly completed.

THE Waterbury water famine continues. The water in the reservoir is 10 feet below high-water mark.

A NEW bridge is to be built over Fleming Creek on the Cincinnati and Southeastern.

NEW LINE.—A corps of engineers has been at Henry, Ill., surveying a route from that point to Chicago. Shortly after their departure another party of engineers arrived from the Southwest, having located the line from the Mississippi River. This is thought to be an air line from Chicago to Kansas City.

THE Fall Brook Railroad company's engineers are now at work running a line for a standard gauge railroad up Senusius Creek, about three miles above Knoxville, thence southeast through the township of Chatham to a point on the C. C. & A. Railroad near Niles Valley or Middlebury (Pa.). The connection above Knoxville will be with the Cowanesque Valley Railroad at that point. The distance from Niles Valley to the junction with the Cowanesque Valley road would be from fifteen to eighteen miles.

NEW RAILROAD.—A company has just been organized in Chicago to build a railroad from Danville, Ill., to Ritchie, Ill., a point on the Chicago division of the Wabash, St. Louis & Pacific Railway, with the following named gentleman as incorporators; Jay Guld, Russell Sage, T. W. Evans, Thomas F. Ryan, A. L. Hopkins, New

York, and John E. Green, Louisville, Ky., one half the number being Wabash directors and one half Evansville and Terre Haute, which latter road is controlled by Louisville and Nashville. This road when completed will form an air line between Chicago and the South via Wabash and Louisville and Nashville.

THE Terre Haute people are opposed to the Charleston, Martinsville & Nashville from Charleston, Ill., to Vincennes.

THE CHAPMAN VALVE WORKS, at Indian Orchard, are full of business. New buildings have been added to the original plant, first erected in 1875. The structures now cover a large tract of ground nearly in the form of a quadrangle, and, being all brick, present almost the appearance of a walled town. Running directly through this mass of building is a spur track of the Boston and Albany Railroad connecting with both the main line and the Athol branch. The iron used is of the best quality, and comes directly from the smelting furnaces. In all departments of the work about 120 men are employed to turn out 4500 valves and hydrants a month.

THE LONG BRANCH PIER NOT SOLD.—*To the Editor of the New York Times:* I notice in your issue of this date a reported sale of the Long Branch Ocean Pier to the Central Railroad of New Jersey for $97.500, etc., which I beg you will correct, as no such sale has been made. The Long Branch Ocean Pier has increased in popularity at the Branch and with the traveling public, and neither can be anxious to see it remove to Asbury Park for the sake of paying $1.50 fare to Long Branch instead of 60 cents via steamer to the pier, and the stockholders have no reason to be anxious to sacrifice a property so well supported by the public, and we expect to open the next season with increased facilities and reduced fares, and show their appreciation of this season's success by making the ocean route more popular than ever.

WILLIAM OTTMAN,
President Long Branch Ocean Pier Company.
NEW YORK, Friday, Nov. 9, 1883.

THE HUDSON RIVER TUNNEL.—The Jersey end of the tunnel has been closed for the winter, and all work suspended. Up to this time the air pressure had been kept up at that end, and the tunnel dry. The structure is in good order. This action is taken while awaiting new financial arrangements. The management hope to resume work early in the coming year.

THE NIAGARA CANTILEVER BRIDGE.—This bridge is so far advanced that the span across the gorge has been begun. On the American side, the section above the steel tower is completed and the connection cords and the large steel posts for the next section have been put in place. On the American side everything is completed for the connection except the trestle work and the placing of the girders across Spring street, and the work is expected to be begun next week. On the Canada side rapid progress is making. Two of the abutments are completed, and the work on the others and on the piers is well advanced. The large cut on the Welland cut-off is being prosecuted vigorously, and week after next will in all probability see it finished. The new bridge contractors are determined that none of the workmen shall go to destruction by way of the cantilever and the rapids, and are constructing huge platforms to hang under the workmen while constructing the river arms of the bridge.

CUTTING DOWN EXPENSES.—The Gulf, Colorado & Santa Fé discharged 400 men lately. Two other roads from Galveston are also dispensing with employés.

IN BAD COMPANY.—The Manitoba itself is not a bad road. It has developed a remarkable traffic in the four years since its reorganization and its large earnings in 1882 were genuine. The road passes through a very productive section and is the normal outlet and inlet to the Winnipeg region of the Dominion, and if its traffic were permitted to take its natural course the earnings of the road for 1883 would have been at least equal to those of 1882. The road is now operated in the interest of that sublime bubble of the hour, the Canadian Pacific. The traffic of the Red River Valley, instead of passing southward toward Minneapolis, is hauled northward to the Canadian Pacific, thence to Fort William and over the lake to the east and Montreal. In order to give the Canadian Pacific the appearance of business it must rob the Manitoba road of its share of earnings and apply them to its own account. The Canadian Pacific line is open from Montreal to Georgian Bay, through a territory that does not furnish enough traffic to pay the wages of its station masters. The company run a line of steamers from the western terminus of the eastern division of the road to Fort William, on the north shore of Lake Superior, and from thence to Manitoba has opened a line of road across the most unpromising section of territory this side of the North Pole. Without the Manitoba traffic the gross earnings of this line would be insufficient to pay for the fuel consumed by its steamers, and, by stripping the Minnesota & Manitoba road of its proper share of traffic, is not earning the running expenses of the road by the way of the lakes. The Manitoba route is the victim; or, perhaps, it would be more nearly correct to say that this road, in conjunction with the Dominion Ministry, is being used to victimize the New York and London stock markets. Like old dog Tray, the Manitoba road has had the misfortune of falling in with bad company.—*Daily Stockholder.*

CANADIAN PACIFIC GUARANTEE.—OTTAWA, Ont., Nov. 15.—George Stephen, President, and W. C. Vanhorne, General Manager, of the Canadian Pacific Railway, were here to-day, and had an interview with the members of the government. It is intimated that a further modification of guarantee arrangements is on the tapis. The President has given $57,000 worth of stock to the Montreal General Hospital, which institution thereby becomes a stockholder in the Canadian Pacific Railway. The Montreal organ of the government excuses the guarantee scheme on the ground that the railway is now so far advanced that to turn back would be to discredit the whole enterprise and acknowledge the worthless character of the Canadian Northwest. Explorers who have lately returned to Ontario say that the line of the Canadian Pacific Road passes for about 300 miles over a desert plain, which can never be of any use for agricultural purposes. The company, however, proposes to start experimental farms at places where the soil appears to be capable of cultivation.

NO ST. LAWRENCE BRIDGE.—The Dominion Government have adopted the report of the Chief Engineer of Railways and Canals against bridging the St. Lawrence, between Morrisburg and Waddington, in the interest of navigation. A suspension had been proposed, in connection with the Ottawa, Waddington & New York Railway, and the plans approved by the United States Engineers as in nowise obstructing navigation.

THE DANVILLE & ST. LOUIS Railroad Company, a road which as yet exists on paper only and has done no other work except to make surveys and locate a line, is said to be in trouble and has stopped further work for the present. Mr. Charles McNay, Resident Engineer, has been dismissed, and has just brought suit against the company for the amount of $1,500.

THE SURVEYING PARTY that has been establishing the boundary line between Deer Lodge and Missoula Counties (Mont.) has stopped work for the year. G. A. Kellogg was in charge, and reports a very rough and unexplored country.

THE Topeka, Saleno & Western will now, it is said, be finished.

THE South Pennsylvania has Pittsburgh as its objective point. There will be ten tunnels on the line, seven of which will be long. Contracts have been let for the construction of five- There is one through the Blue Mountains, and one through the Kittanning Mountains. Then there is one in the Tuscarora Mountains, one in Sideling Hill, one in Ray's Hill, one in the Alleghany Mountains, and one through Laurel Hill. The work of building the road is to begin on the 15th inst.

THE survey of the entire line of the Ottawa & Gatineau Valley Road is now completed to Desert. The second survey of the Ottawa Colonization Railway has been begun near Buckingham.

THE Survey Department of Philadelphia has had its appropriation curtailed by $5,740.

NEW water-works are to be constructed at Madison Barracks, Sackett's Harbor, costing $19.000.

WATER FAMINE IN NORFOLK, VA.—The Mayor of the city calls the attention of the citizens in a special message to the inefficiency of the present water supply. The fire pressure is low and for times in the day many households suffer from want of water for household purposes. He closes by saying that the Water Department is in a deplorable condition.

BUFFALO WATER-WORKS.—Bids for the new pumping engines were opened November 8. It was desired to increase the capacity of the water-works from 15,000,000 to 25,000,000 gallons daily. Bids from three firms were received, making thirteen propositions. From Henry R. Worthington, New York, were received six propositions; from the Holly Manufacturing Company, of Lockport, four; and from the Knowles Steam Pump Works, by the Pittston Steam Machinery Company of Pittston, Pa., three propositions. The bids were:

Henry R. Worthington—For one engine, capacity of 18,000,000 gallons daily, and a duty guaranteed of 70,000,000 gallons, $81,500; two engines, of 12,500,000 gallons daily, and a duty of 70,000,000 gallons, $128,600; one engine, 25,000,000 gallons, $100,600; one engine, 18,000,000 gallons, $95,500; for two engines, each of a capacity of 12,500,000 gallons, $144,600; one engine, 25,000,000 gallons, $156,600.

Holly Manufacturing Company—For one engine, capacity of 10,000,000 gallons daily, and a duty guaranteed of 100,000,000 gallons, $109,000; one beam engine of 15,000,000 gallons, $118,000; for one horizontal engine, capacity of 15,000,000 gallons, $83,000; two horizontal engines, each of a capacity of 15,000,000 gallons, $155,000.

Knowles Steam Pump Works—For one engine, capacity of 15,000,000 gallons, $71,500; for two engines, each of a capacity of 10,000,000 gallons, $108,000; for two engines, each of a capacity of 12,500,000 gallons, $123,000.

The Commissioners reserved decision.

THE ARLBERG TUNNEL was completed Nov. 14, 1883, as far as the melting of the headings is concerned. Considerable work still remains to be done before the tunnel can be opened to traffic.

ANOTHER NEW PENN. RAILROAD—A charter was issued Nov. 14 to the Chest Creek Railroad Company to build a road from near Kaylor's Station, Ebensburg Branch Railroad, Cambria County, to the mouth of Chest Creek, Clearfield County. The length of the road is to be thirty-five miles, and the capital is placed at $400,000. John Patton, of Curwensville, is president.

IRON, METAL AND COAL MARKETS.

PHILADELPHIA, NOV. 23.

Requirements for engineering purposes are coming to hand this week, resulting in transactions for about 700 tons of shapes. There are inquiries in hand and negotiations not far distant for large quantities aggregating some 15,000 tons, for forge iron chiefly, which will be placed probably between now and the end of next month. The structural works are fairly supplied with business, and will probably remain so all winter. To-day's quotations are, 2.30@2.40c. for Angles, 2.80@3c for Tees, and 3.40@3.50c. for Beams and Channels. Plate Iron is 2.50c.; Shell, 3@3.25c.; and Flange, 4@4.25c. A few hundred tons have been ordered this week. Shipyard requirements continue to absorb most of the output. The retail demand is up to that of last month, and the average prices for small lots firm. Steel Rails are $35 per ton for winter and spring delivery, and $36@$37 in small lots. 7,000 or 8,000 tons have been ordered this week; heavy negotiations are hanging fire on account of the belief among large consumers that this month's inside figures are not the lowest. Foreign irons are without activity, although there is active inquiry for Tees at $23 and Double-Heads at $25. A few hundred tons of American Rails have sold at $24. Railroads are holding old material high. Transactions in Pig Iron this week have been mainly in forge at $18 for Northern and Southern irons, in 500 to 1,000 ton lots. Both numbers of Foundry are dull, and range from $18 to $21. The outlook is a little more encouraging, according to makers' opinions, but actual transactions show no improvement either in demand or prices.

PITTSBURGH.

Reports from outside furnaces show a gradual depletion of stocks of good makes of iron, but the stocks of inferior irons are abundant enough to depress the market. Local Furnaces are still well sold up; a few large lots of Forge have been made at $17@$17.25. Very little Foundry is moving. American crop ends, $23.50; Foreign, $25.25. Very few steel mills are working to full capacity. Steel Rails for Spring delivery, $35. Old Rails, American, $23.50; best, $24.50. Merchant bar is fluctuating from $1.75@$1.90.

The railroad companies have not yet agreed upon a division of the coke traffic. There are a number of inquiries for old material, and Eastern brokers have orders to purchase at fixed figures. The second attempt to settle the window-glass strike has failed. Stocks are being received from the East, but this source of supply will probably be cut off, through the refusal of the Eastern workmen to fill Western orders. The strike of the Fourth pool miners still continues.

COAL.

A slight accumulation of stocks in New York market is having a depressing effect upon local prices. The question of restriction is once more being talked of, and will probably be decided favorably to the producing interests in December. The bulk of heavy orders have been placed for the season. During the past week a number of small operators have been shipping in and selling at the best prices obtainable. Some large New England consumers have been placing orders here, to be delivered before the close of the active season. In a few cases concessions have been granted. The anthracite trade will restrict output unless circular rates can be held. Production up to last Saturday, in round numbers, 27,200,000 tons; the Reading output for the last week reported, 305,000 tons. Stocks at Port Richmond, 80,000 tons.

Bituminous shipments, 108,017 tons for last week reported, and for year to same date, 4,154,258 tons Clearfield shipments for week, 50,000 gross tons, and Cumberland, 57,000 tons. The Clearfield operators are to be provided with 1,000 additional cars. An attempt is being made to organize a syndicate for the purpose of controlling the local and line traffic in the interests of higher prices. Most of the trade going from this region is at cost. The bituminous trade generally is unusually dull, but the tidewater traffic pays better prices, owing to the greater unanimity among operators.